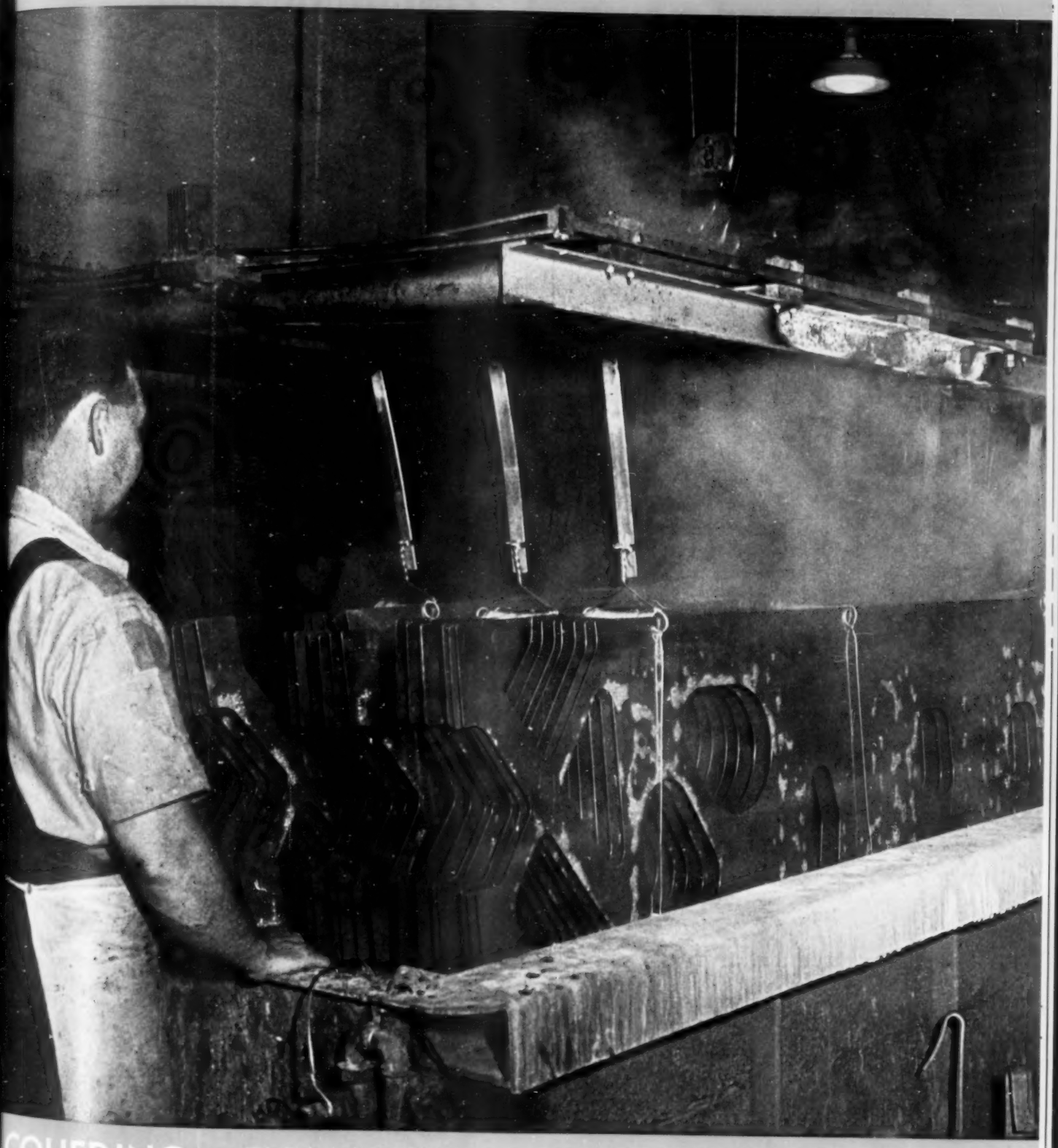
JUNE, 1941

ORGANIC FINISHING

SECTION OF METAL FINISHING



CQUERING • ENAMELING • JAPANNING • PAINTING

ARE YOU WORRIED ABOUT SUPPLIES BEING STOPPED OR RATIONED?

IN THE FINISHING FIELD ZAPON CAN HELP

As defense activities pound at an ever higher tempo, the scarcity of many materials becomes daily more marked. In the finishing field for instance, various raw materials essential to industrial finishes are rapidly becoming harder to obtain. Costs of these materials, of course, have increased and are still increasing.

We at Zapon believe we can supply an answer to the urgent question of filling many of these gaps. Such is the wide range of Zapon finishes, so thorough has been our research in finishing materials, that we feel exceptionally well qualified to help solve these problems.

We feel certain that we can supply satisfactory finishes based on materials which are reasonably available and less likely to feel the pinch of the emergency. Such finishes will not be makeshifts hastily thrown together, but proven, widely used Zapon products. If you will tell us your finishing problem, we will go to work on it.

FOR EXAMPLE:

XE-606-A, Zapon Lacquer enamel, is but one example of how we have been able to substitute acceptable materials for materials hitherto used which are now hard to obtain or which have gone up in price.

XE-606-A, used on metals, plastics and other surfaces, has excellent gloss and hiding power. It is extremely durable, flexible and highly resistant to chipping. XE-606-A comes in a wide range of colors and may be force-dried or air dried. A number of companies are using this grade to their own definite advantage.

ZAPON

REG. U. S. PAT. OFF.

ZAPON DIVISION · ATLAS POWDER COMPANY

Eastern Sales: Stamford, Conn. *Western Sales:* North Chicago, Ill.

INDUSTRIAL FINISHES

Section of
METAL FINISHING
Founded January, 1903 as Metal Industry
Publication Office
116 John Street, New York

ORGANIC FINISHING

SECTION OF METAL FINISHING

JUNE, 1941

CONTENTS

ARTICLES

The Finishing of Rolled Zinc and Zinc Alloy Die Castings—By Dr. A. C. Elm 338

DEPARTMENTS

Solvents in Industry 343
Shop Problems 344
Organic Finishing Digest ..345
New Equipment and Supplies 348
Manufacturers' Literature ..349

PICTURE ON COVER

The picture on the cover was printed through the courtesy of Lockheed Aircraft Corp., Burbank, Cal. The view is in an anodizing shop, showing a loaded rack being raised with an electric hoist out of a hot tank cleaner solution.

Surface Tension of Finishing Materials

One of the very important advances made in the technology of organic finishing was the recognition of the role of viscosity of finishing materials. In a few short years the effect of viscosity on flow and other properties of finishing materials has become pretty generally understood and the control of viscosity of lacquers, paints, enamels, etc. is a regular and important procedure wherever efficient finishing is practiced.

There are, however, certain properties of finishing materials which do not seem to be entirely a function of viscosity. Some factor other than viscosity appears to exert a considerable effect on, for example, the ability of a material to resist pimpling. This factor is probably also responsible, in part at least, for the ability of some finishing materials to give good coverage on sharp edges, to resist bridging, etc.

It is believed—and investigations to date point to the fact—that the answer lies in that physical characteristic of liquids known as surface tension. Surface tension is that strain which exists at the surface of a liquid in contact with air and causes the surface to act as an elastic membrane. In the body of any liquid, the molecules of the liquid are acted upon on all sides by the other molecules so that any one molecule is subjected to equal forces on all sides. At the surface of the liquid, however, the molecules are subjected to unbalanced forces since the attraction on these molecules from the body of the liquid is not the same as the attraction from the air. The result is that the layer of molecules at the surface is drawn inward and, hence, the surface layer of molecules tends to act as a skin or membrane.

From the above it is reasonable to assume that bridging, pimpling, etc. are importantly associated with surface tension. It is also reasonable to assume that, as more is learned about surface tension and its effects on finishing, the control of surface tension will become as much a part of finishing as the control of viscosity is now. It will be one more step toward efficient, trouble-free finishing.

L. H. LANGDON, *Publisher* • T. A. TRUMBOUR, *Business Manager* • DR. WALTER R. MEYER, *Editor*

The Finishing of Rolled Zinc and Zinc Alloy Die Castings

By DR. A. C. ELM

Research Division, The New Jersey Zinc Company (of Pa.), Palmerton, Pennsylvania.

A discussion of the factors leading to adherent organic coatings on zinc alloy die castings and rolled zinc. It is pointed out that poor adhesion of the finish is due primarily to improper removal of grease or oxides, rather than from a reaction between the zinc and components of the finish. Cleaning, pre-treating, baking temperatures and factors to be considered in choosing finishing materials are discussed.—Ed.

Introduction

Many articles fashioned from rolled zinc or die cast from zinc alloys are finished with organic coatings to increase their eye appeal and to protect them against attack by the elements with which they come in contact during their natural service life.

Recent developments in organic coating materials have greatly increased the range of possible decorative effects. The finisher now can make his selection from a wide variety of finishing materials ranging from white to black through all colors and shades, from wrinkle finishes through dull luster to the highest gloss. In choosing a finishing system for a given article, the successful finisher does not only consider the initial decorative effect to be produced but takes into account the probable permanence of the decorative effect or the durability of the finishing system under the conditions to which the articles may be exposed. It is obvious that in most cases a finish, no matter how beautiful it may be when freshly applied, will give rise to serious objections when it discolors, loses its gloss, cracks or peels within a relatively short time after the article has been taken into service. The finisher who cooperates and consults with the manufacturer and supplier of his finishing materials will have little difficulty in selecting a lacquer, enamel or varnish which, besides possessing the color and gloss characteristics desired, may also be expected to be sufficiently resistant to abrasion, perspiration, moisture, solvents and chemicals to give satisfactory service under the conditions of actual use. Proper adhesion and adhesion retention of the finish to the metal surface, however, is largely the result of the skill and care exercised by the finisher in the preparation and the coating of the article.

Many finishers have gained the impression that zinc and its alloys present a difficult and costly finishing problem. They are of the opinion that the peculiar chemical and physical characteristics of zinc quickly destroy the adhesion of any organic coating. In this view they are supported by some research investigators who have come to the conclusion that the loss of adhesion of an organic coating to a zinc surface is due to a chemical reaction between the zinc and some acidic decomposition product of the film binder. There is some experimental evidence, however, which throws considerable doubt upon this viewpoint. It seems to be more in harmony with the known facts and with practical experience to assume that an organic coating may lose its adhesion to a zinc surface because of the presence of or reaction with a layer of corrosion product which prevents a permanent bond between the coating and the metal. The analogy with steel is immediately evident and makes this viewpoint more acceptable. It is readily appreciated then that it is possible to produce coatings possessing satisfactory adhesion and adhesion retention properties. All that is needed is to take the necessary care in preparing the zinc surface to be finished.

Dr. A. C. Elm

Adequate cleaning and pretreating of steel surfaces have been so generally accepted as the sine qua non of satisfactory finishing that it is never questioned. No commercial finisher would think of applying a lacquer or enamel to a rusty steel cabinet and expect the finish to last. In fact, in finishing fabricated steel articles it is widely accepted practice not only to clean all surfaces thoroughly of grease, dirt and rust, but also to give them a chemical pretreatment to minimize the danger of corrosion spreading underneath the finish from damaged areas, and to improve the adhesion and especially the adhesion retention properties of the organic coating. The only difference between steel and zinc is that the corrosion product of steel is highly colored while the corrosion product of zinc is not easily recognized. Yet each zinc article carries a thin layer of atmospheric corrosion product which is not firmly enough bonded to the surface of the metal to insure good adhesion and adhesion retention of organic coatings applied over it. Like steel, zinc has

to be properly cleaned and pretreated for best results.

Cleaning

Proper cleaning involves the complete removal of all dirt and grease picked up during fabrication and handling as well as any oxide or other films developed during storage or in the cleaning operation. For this purpose the finisher has available several methods which have been used with considerable success.*

Solvent cleaning in its various forms is quite effective in removing grease and dirt but does not remove the oxide film unless combined with an acid rinse. The number of solvents available for this purpose is so large and covers such a wide range in boiling point, volatility, solvent power and other essential properties that almost any combination of requirements can be met. Among the solvents which have found application in solvent cleaning and degreasing are petroleum hydrocarbons, coal tar products and chlorinated compounds. The last named solvents have met with considerable favor mainly because of their nonflammability and excellent solvent power. To insure best results, the solvent must be carefully selected and the method of use must be given ample consideration.

Aside from minor modifications, all cleaning methods using organic solvents are based on either of two principles. In one of these two types of process, the article to be degreased is immersed in a bath of solvent maintained at or near its boiling point, allowed to remain in it until its temperature has risen to that of the bath and is then removed. The grease and dirt adhering to the article are removed in the bath and the hot article dries quickly after removal from the bath. Unless a sufficient number of baths are provided for, this method suffers from one serious drawback. The solvent quickly becomes contaminated with grease and dirt and the articles coming from the cleaning cycle are not clean enough to receive the finish. To overcome this defect, vapor degreasing machines and procedures were developed. According to this method the

*For an extensive review of cleaning methods, see The Metal Cleaning Handbook by R. W. Mitchell, Magnus Chemical Company, Garwood, New Jersey and several articles in Metal Cleaning and Finishing, 7, January to March, (1935).

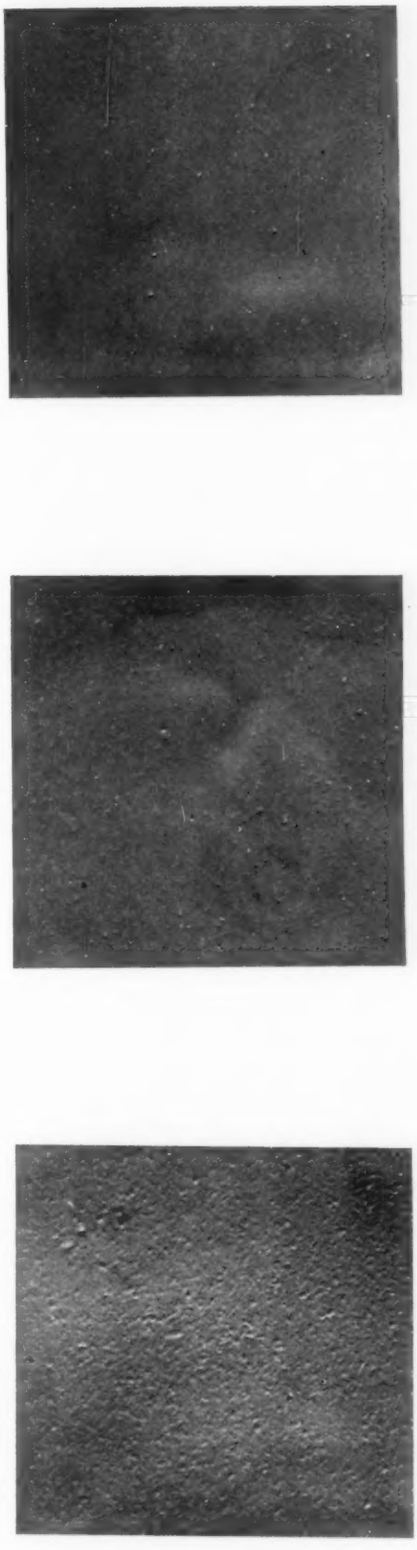


Figure 1

The appearance of a gray baking enamel finish (two coats) on sand blasted Zamak-3. The second panel would require at least one, and the third panel, two additional coats of enamel to produce a reasonably smooth finish.

cold article is immersed in the vapor above a bath of solvent kept near its boiling point by suitable heaters. The vapors condense on the cold article, dissolve the grease and oil adhering to it and run back into the bath. Since the boiling point of the grease is appreciably above that of the solvent, the solvent vapor coming in contact with and condensing on the article is substantially pure, thus insuring a perfectly clean metal surface. There are also degreasing installations which combine certain features of both the solvent and the vapor degreasing methods. The choice of the degreasing method to be used in any finishing cycle depends on many considerations which cannot be discussed in this article.† In any case, the finisher, however, must be certain that the article is absolutely free from grease or oil before the organic coating is applied.

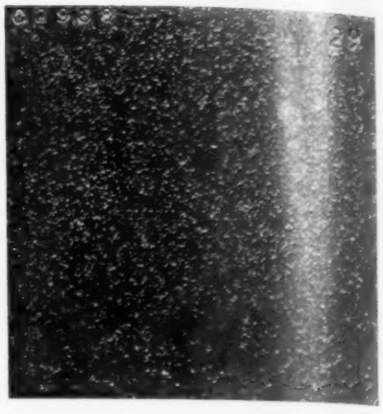
Alkaline cleaning is increasing in importance as a method for preparing metal surfaces for finishing. Many new alkaline compounds ranging from soaps to silicates have been developed in recent years‡, and make alkaline cleaning processes very flexible and adaptable to almost any finishing cycle. Complete removal of grease by this means is difficult unless electric current is used. The cleaning cycle should be so designed as to remove all grease and oil in about a minute. To accomplish this it is advisable to pass a direct current of 6 volts and 40 amperes per square foot through the cleaning solution with the article to be cleaned as the cathode. Care should be taken that the hydrogen evolution on the surface of the article is violent enough to insure the removal of all contaminants by the mechanical and detergent action of the gas bubbles. Alternative rinsing in hot and cold water should follow to remove the adhering cleaning solution. The thin film of alkaline salts which alkaline cleaning leaves on the zinc is not removed by the water rinses and should be dissolved by a brief immersion of about five seconds' duration in a cold ten per cent hydrochloric acid solution. This dip will also remove the oxide film. It should be followed by a hot water rinse to remove the adherent acid and to facilitate drying. If the article is to be given a chemical pretreatment before being finished with an organic coating, this acid dip may be eliminated.

Pretreating

Although good cleaning is essential to good finishing, the fact that the metal surface had been cleaned thoroughly before finishing does not necessarily guarantee satisfactory adhesion or adhesion retention of the organic coating under all conditions of exposure. In many cases the service requirements are light enough and the length of service expected is short enough so that the above described cleaning methods may be considered adequate preparation for painting. In the majority of the cases, however, the organic coating is supposed to retain its appearance, integrity and especially adhesion over an extended period. Simple cleaning is not sufficient to insure that the finish will retain the desired adhesion to the zinc surfaces. A mechanical or chemical pretreatment is frequently required.

Perhaps one of the most effective means for preparing a metal surface for the application of an organic finish is by sand or grit blasting. Grease and oxide films are removed and the surface is roughened to promote good adhesion and adhesion retention. The particle size of the sand must be determined from case to case giving proper consideration to the shape and design of the casting, the type of appearance desired, the number of coats to be applied, and the properties of the finishing material. A casting of intricate design and containing nibs, cross bars and other fine detail should not be sandblasted or should be sandblasted only with suitably fine sand and with the greatest of care to avoid damage. It is easy to understand that the use of an excessively coarse grit will leave the surface so rough that a large number of coats or a finishing material of exceptionally good filling properties is necessary to produce a smooth and glossy finish (Figure 1).

The use of excessively coarse grit or an improper blasting technique may also result in an early failure of the finish under some exposure conditions although a sufficient number of coats may have been applied to produce a finish of good appearance. An example is shown in Figure 2. A Zamak-3 panel was blasted with a sand of medium particle size, the gun being held fairly close to the panel surface to produce relatively deep pits. One coat of a gray baking enamel was then applied with sufficient thickness to yield a smooth finish of quite satisfactory appearance and gloss. After a relatively short exposure to a high humidity atmosphere, pimples began to appear near the high spots of the panel where the paint film was not sufficiently thick to prevent the moisture from penetrating to the metal surface. This condition is shown in the schematic drawing of a cross-section through a finished panel in Figure 2.



A Zamak-3 panel, sand blasted with medium sized sand, and finished with one coat of a gray baking enamel after exposure to high humidity for several weeks.

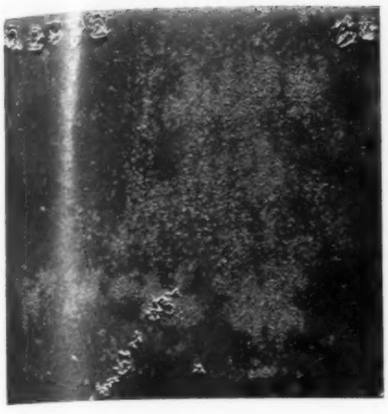
Schematic sketch of a cross section through a sand blasted panel finished with four coats of an enamel.

Figure 2

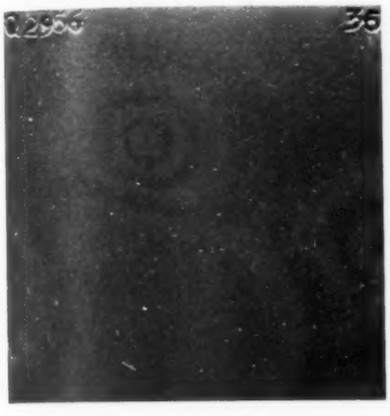
The effect of blasting with coarse sand on the durability of an organic finish. If the sand is too coarse, the finish although perfectly smooth, may not be thick enough over the high points to afford adequate protection under some exposure conditions unless extra coats are applied.

†For details the reader is referred to "Principles of Solvent Degreasing" by M. Marean, Metal Cleaning & Finishing, **8**, 553-8, 590, September (1936).

‡See Recent Advances in Metal Cleaning Technology, by R. W. Mitchell, Metal Cleaning & Finishing, **7**, pages 9, 65, 133 (1935).



Cleaned but not pretreated



Cleaned and properly pretreated

Figure 3

The effect of pretreating on the durability of a finish on Zamak-3. Both panels were finished with two coats of a baking enamel and exposed to high humidity for several weeks.

Some investigators believe that the beneficial effect of sandblasting upon the adhesion and adhesion retention of organic finishes is due to the complete removal of all grease, dirt and other contaminants, and the tremendous increase in the surface area of the metal or, in other words, the contact area between the metal and the film. To derive the fullest benefit from sand or grit blasting, it is essential that the organic coating be applied as soon as possible after sandblasting has been completed, and to avoid any contamination of the clean surface by grease, dirt, and perspiration. If the sandblasted articles are stored for some time, an oxide or basic carbonate film will form again and much of the benefit of sandblasting will be lost. Allowing the surface of a sandblasted article to become contaminated again is perhaps responsible for most of the contradictory results that have been obtained with this method of surface preparation. Disregarding cost considerations, sand or grit blasting might be considered the outstanding method of cleaning and pretreating zinc surfaces, if it were not for the limitations imposed by appearance requirements.

Chemical pretreatment is not subject to the same limitations. Properly executed chemical pretreatments not only remove all traces of surface contaminants but deposit on the metal surface a tenaciously adherent and porous film which makes an excellent base for an organic coating. This film absorbs enough of the first paint coat applied over it to anchor it securely (Figure 3) without, however, materially affecting the appearance of the final finish. In most cases, two coats —a primer and a finishing coat—are sufficient to give the article the desired color, gloss, and general appearance.

The finisher has at his disposal several proprietary solutions of the phosphate type which have found wide application as pretreatments for metal surfaces. These solutions may be applied to properly cleaned surfaces either by immersion or by spraying. The time required to transform the metal surface into a phosphate coating is from one to five minutes depending on the method used and the type of product treated. A suitable immersion pretreating plant will usually include a tank for alkaline cleaning, arrangements for water rinses and a tank for the phosphating solution, which is followed by facilities for hot water rinses and a chromic acid dip. Spray application is more readily adapted to modern production methods and may be completely conveyorized. The articles are carried on suitable conveyor lines through various chambers where they are cleaned, phosphate coated, rinsed and dried. Normally, the articles pass then through an oven to make sure that all traces of moisture have been removed from seams, cracks and crevices before they are finished with organic coatings.

When applied to zinc and zinc alloy surfaces these treatments have generally been found to improve adhesion and adhesion retention of organic coatings to such an extent as to make them entirely satisfactory for all practical purposes.

Regardless of the cleaning and pretreating method used, the metal article should be handled with the greatest care, and the application of the organic coating should follow the treatment as soon as possible. The danger of improper handling is often underestimated, simply because the harmful effects frequently do not become evident immediately upon application of the organic coating but develop only after the article has been in use for some time. It has been observed that articles handled carelessly after cleaning and pretreating with a phosphate solution carried finger prints which were not visible after application of the primer and finishing coats. Upon exposure, however, fine blisters or pimples developed on the fingerprinted areas, perfectly outlining the contours of the prints (Figure 4). If, in practice, the exposure were continued long enough the whole area would peel and the finisher without having watched it develop would have a hard time determining the exact reason for this failure.

As previously stated, finishing should follow the pretreatment with all possible speed. It is readily understood why that should be so in the case of sandblasted articles, since the formation of an oxide film on an article exposed to the atmosphere starts immediately. It is a little more difficult to see why phosphate-treated articles could not be stored for some time before application of the organic coating. It may be reasoned that because of the presence of the phosphate coating no harmful oxide film could be formed. Although this reasoning seems entirely correct, experience has shown that it is advisable to finish phosphated zinc articles without delay. The exact reasons for the inferior adhesion and adhesion retention of organic coatings to aged phosphated zinc surfaces is not known but it may be assumed that phosphate coatings, because of their porosity, may absorb dirt and other contaminants from the atmosphere which seriously interfere with their function which is to improve the adhesion properties of the organic finish.

Baking Temperatures

Most modern finishes used on metal articles formed from rolled zinc or die cast from zinc alloys are either force dried or baked. This is fortunate since drying at elevated temperatures materially adds to the durability and adhesion properties. However, in selecting baking finishes for zinc base alloy articles, the finisher should keep in mind that zinc is a material of relatively low melting point and that very high baking temperatures might exert a harmful effect upon the strength of the article. It is difficult to set any exact temperature limits since they vary somewhat with the degree of deformation suffered by rolled zinc during fabrication and the general structure and shape of the die cast article.*

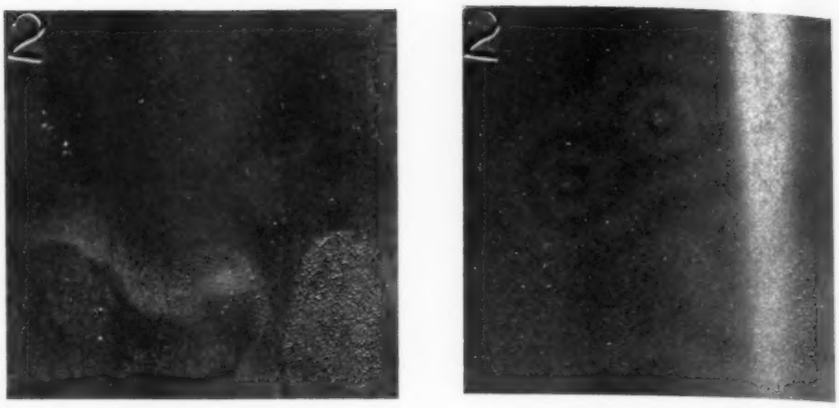
These temperature limits, however, do not seriously handicap the finisher in the selection of his finishing materials. There are plenty of varnishes and enamels which produce the desired finish effects at temperatures below the necessary maxima. It is anticipated that this situation will improve still further as the efforts of the paint formulators to develop low temperature baking enamels bear fruit.

Choosing the Finishing Material

It is not the purpose of this discussion to imply that any organic coating when applied to properly cleaned and pretreated zinc surfaces will give satisfactory service, especially that it will exhibit the desired adhesion and adhesion retention properties. All experienced finishers realize that organic finishing materials differ in their ability to produce films of sufficient adhesion to any metal surface. They also know that in the formulation of organic coating materials it is at times necessary to strike a compromise between adhesion on one side and general appearance and durability properties on the other. It has become general practice to use special primers if it is essential to produce a finish effect which is not compatible with good adhesion or adhesion retention. The primer serves as a bond between the finishing coat and the metal surface. This principle is applied so generally in the finishing of steel and other metal articles that its application to the finishing of zinc articles should not encounter any obstacles.

The selection of the proper coating material then consists of choosing the best combination of primer and finishing coat materials for any given job. The necessary prerequisites for an intelligent selection include sufficient knowledge of the service requirements, the nature of the surface to be coated and the properties and behavior of the finishing material. Since the commercial finisher cannot be expected to have all of this information at his finger tips it seems advisable that he consult freely with the supplier or manufacturer of his finishing materials. The proper cooperation between the finish manufacturer and the commercial finisher should result in the selection not only of the best finishing system for any given job but should also result in the selection of the most suitable cleaning and pretreating methods. This cooperation may be expected materially to reduce finishing troubles and to enhance appreciably the quality of organic finishes.

*When in doubt, the finisher is advised to consult with the manufacturer of the article to be finished.



Untreated Zamak-3 | Phosphate pretreated Zamak-3

Figure 4

The effect of careless handling of either zinc or steel on the durability of a baking enamel finish. There are three finger-prints near the bottom of each panel. From left to right, they are a print from a relatively clean finger, a print from a dirty finger, and a print from a greasy finger. The prints were not visible immediately after the finish was baked. However, they caused pimpling upon exposure to high humidity.

Untreated steel

Acknowledgment

The author gratefully acknowledges the suggestions and criticisms offered by various members of the Research Division of The New Jersey Zinc Company (of Pa.) and the help given by A. J. Person in the preparation of the illustrations.

Solvents in Industry

Carbon Tetrachloride

(Tetrachloromethane, perchloromethane, benzinoform, tetra, phenoxin, pyrex, etc.)

Physical Properties

Carbon tetrachloride is a heavy, colorless liquid of the chlorinated aliphatic hydrocarbon type having the molecular formula CCl_4. Its molecular weight is 153.84.

Pure carbon tetrachloride is listed as having a specific gravity of 1.595 at 70°F. (approximately 13.4 pounds per gallon). Its boiling point at 760 mm. mercury pressure is 76.74°C. and its freezing point is −23.0°C.

Other physical constants are as follows:

Heat of vaporization	83.7 BTU/lb. at 170°F.
Heat of fusion	7.6 BTU/lb.
Specific heat of vapor	0.115 cal./kg./°C. at 170°F.
Specific heat of liquid	0.216 BTU/lb./°F. at 170°F.
Refractive index	1.4607 at 20°C.

With most solvents including alcohols, esters, ketones, other chlorinated hydrocarbons, etc., carbon tetrachloride is entirely miscible. Water, however, is soluble in it only to about 0.84 per cent by weight at 20°C. It will dissolve fats, waxes, resins, metallic resinates, bitumens, rubber, camphor, etc. Its solvent power for cellulose esters and ethers is enhanced by the addition of the lower aliphatic alcohols and acetates.

The vapor pressure of carbon tetrachloride ranges from 33.4 mm. of mercury at 0°C. to 141.1 mm. at 30°C. It has a volatility of 3 as compared with ether, taken arbitrarily as having a value of 1. It is non-explosive and non-flammable.

At low and moderate temperatures, carbon tetrachloride is stable to water and to light. It may or may not be stable to metals, depending on conditions. In general, stainless steel, monel metal and nickel may be regarded as being very inert. Tin, lead and zinc may also be used for most industrial purposes. Aluminum is resistant up to about 60°C. Above this temperature its effect depends on atmospheric humidity. Iron is not suitable, although it has little or no action on dry carbon tetrachloride. If carbon tetrachloride does decompose, phosgene, chloride and hydrochloric acid may be produced.

Uses

Carbon tetrachloride is used extensively as a solvent, diluent, etc., because of its great solvent powers and non-flammability. It finds application in the cleaning and degreasing of metals, cloth, leather, bones, etc. It is used as a fire extinguisher in industry and the home. As a constituent of lacquers, paints, varnishes, rubber cements, polishes, type cleaners, dry cleaners, soaps, floor waxes, printing inks and home dry cleaning compounds it is particularly valuable.

In organic chemistry, carbon tetrachloride serves as a reagent and as the starting point for the synthesis of dyes, drugs, chemicals, etc. It is also used in grain fumigation, moth control and as a delousing agent.

Carbon tetrachloride is often used to reduce the fire hazard of solvents possessing low flash points. For example, the addition of thirty per cent of carbon tetrachloride to V.M. & P. Naphtha raises the flash point by twenty-five to fifty-five degrees Fahrenheit.

Physiological Properties

The vapor of carbon tetrachloride possesses narcotic properties and is somewhat toxicities of carbon tetrachloride and various irritating to the mucous membranes. Derangement of the sight and jaundice may frequently be observed. The maximum concentration of carbon tetrachloride vapor which can be inhaled for one hour without serious disturbances is said to be 4000 to 6300 parts per million parts of air. A concentration of 48000 to 63000 parts per million parts of air is said to be lethal to man if inhaled for thirty minutes. The relative other chlorinated hydrocarbons was given in the "Solvents In Industry" section of the January 1940 issue of Metal Finishing.

Carbon tetrachloride has been used medically as an anthelmintic, especially for the removal of hookworms.

Chemical Properties

Carbon tetrachloride reacts with fuming sulphuric acid to give phosgene ($COCl_2$) and pyrosulphuryl chloride ($S_2O_5Cl_2$).

Reduction of carbon tetrachloride with moist iron gives chloroform, with methylene chloride, hexachloroethane and tetrachloroethylene as by-products.

With alcoholic potassium hydroxide at 100°C., carbon tetrachloride gives CO, KCl and $HC(OC_2H_5)_3$ but does not give K_2CO_3 or orthocarbonate.

p-Hydroxybenzoic acid is made by the action of carbon tetrachloride on phenol in the presence of sodium hydroxide.

Manufacture

Carbon tetrachloride was first prepared by Regnault in 1839 from chloroform and chlorine. It is now produced commercially from carbon bisulphide and sulphur monochloride in the presence of moist iron as a catalyst. The reaction is as follows:

$$CS_2 + 2S_2Cl_2 \longrightarrow CCl_4 + 6S$$

The sulphur is converted to S_2Cl_2 and used again.

The chlorination of methane also produces carbon tetrachloride. This process is not yet commercial.

Solubility of Various Substances in Carbon Tetrachloride

Anthracene	Slightly Soluble
Beeswax	Soluble
Benzyl Cellulose	Gels
Candelilla Wax	Soluble
Carbazol	Slightly Soluble
Carnauba Wax	Soluble
Coumarone Resin	Soluble
Damar Resin (dewaxed)	Soluble
Japan Wax	Soluble
Manila Loba Resin	Largely Soluble
Montan Wax	Soluble
Paraffin Wax	Soluble
Shellac (bleached)	Insoluble
Spermaceti Wax	Soluble
Vinyl Acetate Resin	Partly Soluble

Agateen LACQUERS

All types of Clear Lacquer for Metals

BUFFING LACQUER

for Cloisonne Reproductions

Air-Dry Priming Lacquer

Water Dip Lacquer

Elastic *Non-blushing*

Agate Lacquer Mfg. Co., Inc.

11-13 Forty-third Road, LONG ISLAND CITY, N. Y.

Agateen —*The Last Word in Quality*

Shop Problems

Dust From Chain

Question. Recently we moved a chain conveyor to our finishing room which had been used for some time previous in another part of our plant. This chain is being used to transport parts from our spray booths to the baking oven. After a few weeks operation we found that many of our parts were collecting dust, dirt, etc. which fell from the chain. We tried cleaning the chain daily, which helped, but the dust still continues to some extent. Can you suggest a non-drying paint or oil which we might use on the chain to collect the dust and prevent it from falling on the work?

Answer. It is possible that a paint or oil might help the condition you describe, but another plan can be used to almost entirely eliminate it. This is by using offset hooks, that is, hooks which do not hang straight down but are so bent at an angle as to keep the work away from the chain. Another plan involves the use of a metal shield under the chain around which the hooks are bent. This shield will collect whatever dirt may drop from the chain and thus keep it off the work.

Something NEW under the sun
Stanley found it! And YOU can cash in on it! It's 1617 . . . the ORIGINAL crystal clear, non-spotting lacquer which practically eliminates "spotting out" on cast metals and crystal spotting of oxidized finishes. For performance . . . exceptional adhesion . . . and resistance to exposure without discoloration . . . STANLEY 1617, in the long run, is just about the most economical lacquer you can buy. Try STANLEY 1617 on YOUR product . . . under YOUR conditions. Order a five gallon testing sample TODAY. It will be billed at the drum price. Address Department "G".
THE STANLEY CHEMICAL CO.
STANLEY
EAST BERLIN CONNECTICUT
Lacquers · Enamels · Synthetics · Japans
A SUBSIDIARY OF THE STANLEY WORKS NEW BRITAIN CONN.

Spray Dust

Question. What is the cause of excessive spray dust? We use a small amount of air-drying lacquer on certain of our products and have always had this difficulty. We do not believe that the trouble is due to our equipment or the lacquer but rather to our spraying technique and any help you will give us will be greatly appreciated.

Answer. Excessive overspray may result from holding the gun at too great a distance from the work, from too high spraying pressures, from using a thinner which evaporates too rapidly, or from thinning the material too much. We suggest that you try holding the gun somewhat closer to the work and, if this fails, asking the advice of the manufacturer of the lacquers which you are using. Having such information as the type of work you are finishing and the kind of spray equipment used, he will be able to recommend the optimum thinning ratio and spraying pressures and, if you are not already employing it, the correct thinner.

French Polishing

Question. Will you please acquaint us with the details of "French polishing."

Answer. French polishing is a hand rubbing operation using shellac and an oil which produces a deep and beautiful finish on wood. The procedure is as follows:

Carefully prepare the wood to be finished. Use only water stain and before the polishing is begun, make certain that the wood is thoroughly dry. Prepare a one pound cut of white shellac and apply a uniform coat with a soft cloth rolled into a pad. Use light, straight, rapid strokes. When the film is dry, sand the surface with fine sandpaper. Apply another coat with the pad, allow to dry and sand again. Repeat this procedure until surface becomes slightly glossy. At this point add a few drops of boiled linseed oil to the shellac and apply repeated coats as before, gradually increasing the additions of linseed oil. Use rapid circular strokes. Continue the application of the shellac and linseed oil until the required gloss and appearance is obtained.

ORGANIC FINISHING DIGEST

PATENT AND LITERATURE REVIEWS

Spray Gun

U. S. Pat. 2,228,226 A. H. Downs, assignor to Eclipse Air Brush Co., Inc., Jan. 7, 1941. A spray gun of improved design for lacquer and paints.

Nitrocellulose Lacquer

U. S. Pat. 2,229,328 J. Hyman, assignor to Velsicol Corp., Jan. 21, 1941. A nitrocellulose lacquer containing a hydrocarbon diluent, said diluent containing at least 15% benzol and having an initial boiling point above 176°F., not more than 10% of said diluent boiling below 180°F. and not more than 50% thereof boiling below 187°F. The usual marked toxicity connected with the use of more than 15% benzol is claimed to be minimized.

Corrosion Prevention of Magnesium Alloys

U. S. Pat. 2,229,252 J. M. Michel & F. Henneberger, assignors by mesne assignments, to Magnesium Development Corp., Jan. 21, 1941. The corrosion resistance of magnesium and magnesium alloys is increased by anodizing at room temperature in a solution of a neutral alkali fluoride in a solvent comprising predominantly a polyhydric alcohol such as glycol, the pH being at least 7 and preferably between 8 and 11. *Example*: For magnesium containing 2% manganese and 0.3% silicon.

Glycol	2 parts
Water	1 part
Potassium fluoride, saturated in above mixture.	

Temp.=20-25°C. C.D.=1 amp./sq.dm. initially.
Time=20 min. Voltage=60 volts.

Corrosion Prevention of Magnesium Alloys

U. S. Patent 2,229,236 A. Beck, G. Siebel & E. Nachtigall, assignors, by mesne assignments, to Magnesium Development Corp., Jan. 21, 1941. A process for preventing the corrosion of magnesium and its alloys which involves treatment with an aqueous solution of an ammonium or other salt of an aliphatic carboxylic acid containing at least 8 carbon atoms, at temperatures at least so high as to be in the vicinity of the boiling point of the solution. Also an ammonium or other salt of aromatic carboxylic acid containing at least 2 carbon rings and adapted to act as a dye-stuff component and thereafter treating the article with a solution of a component adapted to produce a dyestuff. Also one of the above aliphatic and aromatic carboxylic acid salts and a phenolate which will react with magnesium to form substantially water insoluble compounds, with or without the addition of a water soluble chromium salt.

Ex.: 5% potassium abietate solution in an autoclave at 180°C. for 15 minutes.

Ex.: 10% potassium naphthenate solution in an autoclave at 170°C for 15 minutes.

Corrosion Prevention of Ferrous Alloys

U. S. Patent 2,228,836 J. MacQuaid, assignor to General Motors Corp., Jan. 14, 1941. An apparatus for applying rapidly, by spraying in a chamber, solutions for producing a rust resisting coating on ferrous alloys. The pressure is sufficiently high to have a scouring effect.

Corrosion Prevention of Magnesium and Alloys

U. S. Pat. 2,228,259 H. K. DeLong & J. B. Reid, assignors to The Dow Chemical Co., Jan. 14, 1941. A method of producing a corrosion-resistant coating on magnesium and its alloys which comprises subjecting the article to the action of an aqueous solution of a soluble alkali metal carbonate under pressure and at a temperature above the normal boiling point of the solution and consequently dyeing the article by immersion in an aqueous solution of a dye. A list of dyes is given in the patent papers. Ex.: 2-20% sodium carbonate (or greater) at 110-250°C. or higher equivalent to 20-400 lbs. per sq. in. pressure for 1-3 minutes. A preferred procedure is 1-5 minutes at 200°C. (equivalent to 225 lbs./sq.in.)

Spray Gun

U. S. Pat. 2,240,401 C. S. Jordan, assignor to A. G. Jordan Mfg. Co., April 29, 1941. An improved paint spray gun.

Rust Prevention and Removal

U. S. Pat. 2,235,944 W. B. D. Penniman, March 25, 1941. A rust preventing and removing composition comprising about 10% of boiled linseed oil including drier, 2% of pine oil, 2% of oleic acid and the remainder petroleum oil distillate.

Coating Aluminum

U. S. Pat. 2,234,206 J. S. Thompson, assignor to Metal Finishing Research Corp., March 11, 1941. An article having a surface of aluminum or aluminum alloy and coated with a substantially closely adherent coating at least 65% of which is a substantially insoluble phosphate of a metal which also forms a soluble acid phosphate and at least 6% of a fluoride. The solution may contain a wide variety of acid phosphates such as iron, manganese, zinc or cadmium.

Example:

Manganese dihydrogen phosphate	80 g./l.
Manganese fluosilicate	500 "
Potassium fluoride	40 "

Apply and allow to dry on the surface, then brush off residue and paint. The manganese dihydrogen phosphate is conveniently prepared by dissolving manganese carbonate in cold phosphoric acid as required to form $Mn(H_2PO_4)_2$.

Anodizing Aluminum and Alloys

U. S. Pat. 2,233,785 J. Korpiun (Germany), assignor, by mesne assignments, to Sherka Chemical Co., Inc., March 4, 1941. Formation of oxide films by anodic oxidation in a bath consisting essentially of an aqueous solution of a sulfonic acid or an aromatic compound containing at least one substituent taken from the class consisting of hydroxy, oxo and carboxyl, such as phenol, cresols and thymol plus a minor amount of a compound taken from the class of sulfuric acid, alkali metal sulfates and sulfates of polyvalent cations.

Example: Cresolsulfonic acid solution of 1.25 specific gravity at 40-50 volts alternating current and 25°C. approx.

Example: Crude phenolsulfonic acid which still contains about 5% by weight of sulfuric acid and which has a density of about 1.2 is employed at 26 volts to produce hard oxide layers.

Coloring Metals

U. S. Pat. 2,236,549 V. M. Darsey, J. S. Thompson and E. W. Goodspeed, assignors to Parker Rust-Proof Co., April 1, 1941. A method of treating metal surfaces such as iron, zinc, copper and aluminum which consists of forming thereon a coating selected from the group consisting of phosphate, oxalate and oxide and coloring such surface with a tris azo dye.

Example: (PHOSPHATE)

Zinc or manganese dihydrogen phosphate	27 lbs.
Water	100 gal.

Dip or spray at 170—210°F.

Example: (OXALATE)

Water	100 gal.
Oxalic acid	40 lbs.
Sodium nitrate or ferric oxalate	8 "

Example: (OXIDE)

Water	100 gal.
Sodium chlorate	4.5 lbs.
Sulfuric acid, 96%	8 "

Example: (DYE)

Water	200 gal.
Water Black "J" #865	50 lbs.
Chromic acid	10 "

Temp. 180—210°F.

Coloring Aluminum Oxide Films

U. S. Pat. 2,237,483 C. Graenacher & M. Matter (Switzerland), assignors to the firm of Society of Chemical Industry in Basle (Switzerland), April 8, 1941. A process of coloring an electrolytic oxide on aluminum and alloys by treating with a solution of a water soluble acyl derivative of a sparingly dyestuff obtained by the reaction, in the presence of pyridine, of a dyestuff containing at least one salt forming salts with alkalies which are hydrolyzed by water, selected from the group consisting of hydroxyl and NH groups, with acylating agents containing at least one group which imparts to the formed product increased water solubility, and then with a solution of a saponifying agent.

Production of Wrinkle Finish

U. S. Pat. 2,236,397 F. E. Drummond, assignor, by mesne assignments, to New Wrinkle, Inc., March 25, 1941. A method of producing wrinkle finish by accelerating the surface drying of the composition in the form of a film comprising the steps of concentrating infra-red heat rays onto the surface and simultaneously subjecting said film to air in which oxygen content has been substantially increased above that normally constituent part of air.

Coating and Decorating Metals

U. S. Pat. 2,209,530 M. W. Mason, assignor to Pittsburgh Plate Glass Co. A process of coating iron, steel and zinc bodies which comprises phosphatizing the surface, coating with a varnish containing a co-polymer of vinyl acetate and vinyl chloride and then applying a decalcomania. The decalcomania embodies a film of vinyl resin containing a co-polymer of vinyl chloride and vinyl acetate upon a paper backing, the film containing blue lead for rendering the resin non-reactive with iron or steel.

Coating Composition

U. S. Patent 2,209,088 G. D. Martin, assignor to Monsanto Chemical Co. Improvement in the manufacture of coating compositions containing a vegetable drying oil such as paint, varnish, enamel, etc., comprising the addition of 0.01—1.0% of thiodiphenylamine. This addition increases the resistance to weather and prevents skinning in the containers.

Removal of Baked Coatings

U. S. Patent 2,208,294 C. H. Hempel, assignor to Heresite and Chemical Corp. The method of removing a baked phenol-formaldehyde coating from a predominantly aluminum base which comprises subjecting the coated base to a bath consisting essentially of sulfuric acid having a specific gravity of at least 1.83 while maintaining the temperature of the bath between 180° and 190°C. and continuing the treatment until the base is bright and clean. Time required is about 20 min.

Rust Removal

U. S. Pat. 2,209,291 G. Witty, assignor by mesne assignments to F. LePan. A rust removing composition comprising phosphoric acid, zinc phosphate (tribasic), gum arabic, manganese chloride, butyl propionate and water. For example:

Phosphoric acid	36	parts by wt.
Zinc phosphate	3	"
Gum arabic	2	"
Manganese chloride	1	"
Butyl propionate	30	"
Water	28	"

Composition removes rust, scale, grease, oil, etc., with minimum attack on the metal surface.

Cleaning Composition and Process

U. S. Pat. 2,208,524 V. M. Darsey and M. J. McVey, assignors to Parker Rust-Proof Corp. A process which comprises subjecting metallic surfaces to the action of a cleaning emulsion containing a petroleum derivative, an alkali soap and water, and thereafter applying to the metallic surfaces a chemical coating composition comprising dilute acid phosphates and oxidizing agents to produce thereon corrosion-resistant and paint holding coatings integral with the metallic surfaces. The essence of the invention is the use of a water soluble soap which will keep kerosene in emulsion with water and the use of this emulsion for cleaning prior to phosphate treatment.

Ex: Triethanolamine oleate soap 9%
Kerosene 59%
Water 32%

DETREX MEETS THE NATION'S METAL CLEANING NEEDS!
At BROOKLYN, N. Y. a model 2DC-600 gas-heated Detrex degreaser with built-in paint dip tank and overhead oven for the cleaning and finishing of electrical equipment.
At SOUTHGATE, CAL., a hand-operated Detrex degreaser cleaning parts for plating.
In plants of every size . . . in every section of the United States and Canada . . . Detrex cleaning equipment and materials are in daily use.
Offering close cooperation with the users of these products is a Detrex organization of experienced cleaning engineers with offices in a number of key cities.
Detrex Degreasers and Washers, Perm-A-Clor and Triad Stabilized Safety Solvents, and Triad Alkali Cleaners are engineered to give you fast, flexible and economical metal cleaning.
Wherever you are . . . whatever your metal cleaning job . . . you can depend on Detrex.
SOLVENT DEGREASING and ALKALI CLEANING
DETROIT REX PRODUCTS COMPANY
13009 HILLVIEW AVENUE • DETROIT, MICHIGAN
Branch Offices in Principal Cities of U. S. A. — In Canada: Canadian Hanson & Van Winkle Co., Ltd., Toronto, Ontario

Dilute to any suitable strength for use by adding water such as 60 or 75 parts water to one part emulsion. Enough soap or emulsifying agent must be present to keep the kerosene from separating out of the emulsion. The addition of alkali to produce a 0.01 N solution in the water before adding the concentrated emulsion improves the stability especially at elevated temperatures.

Examples:

1. Kerosene	59.3 %	by wt.
Oleic acid	5.33%	"
Triethanolamine	2.3 %	"
Water	33.24%	"

The kerosene and acid and the triethanolamine and water are dissolved separately and then mixed. Used as spray or dip at 130-160° F.

2. Fuel oil	119.0	cc.
Oleic acid	10.5	"
Triethanolamine	4.26	"
Water	67.0	"
3. Kerosene	119.0	cc.
Oleic acid	10.5	"
Ammonia	6.0	"
Water	67.0	"
4. Fuel oil	120.0	cc.
Oleic acid	10.5	"
Ammonia	6.0	"
Water	67.0	"
5. Kerosene	59%	
Stearic acid	6%	
Triethanolamine	3%	
Water	32%	

Pyroxylin Lacquer Solvent

U. S. Pat. 2,204,963 P. E. Joyce, assignor to Shell Development Corp. A medium boiling solvent of low cost containing 85% by volume secondary butyl acetate and 15% diacetone alcohol approximately and comprising approximately 25% of the total solvent composition. Also a pyroxylin coating composition which contains a mixture of 70-95% by volume secondary butyl acetate and from 5—30% by volume of diacetone alcohol, said mixture comprising from 5—45% by volume of the total solvent content.

Ex: Spray lacquer thinner consisting of:

Methyl ethyl ketone	16% vol.
Diacetone: secondary butyl acetate mixture of 15:85 ratio	20% vol.
Secondary butyl alcohol	10% vol.
Aliphatic petroleum diluent	50% vol.
Isopropyl alcohol	4% vol.

Technical Publications

Resins of Abietic Acid

A new booklet entitled "Hercolyn and Abalyn, Liquid Resins of Abietic Acid" has just been issued by Hercules Powder Company, Wilmington, Del. In addition to their high refractive index, approximating that of nitrocellulose, the new liquid resins are compatible with almost all of the film-formers, solvents for or compatible with most of the resins, possess very low vapor pressure, are extremely resistant to water, alkalis, weak acids and similar reagents, and can be used as major replacements for both plasticizer and resin without producing tackiness, the booklet says.

The booklet points out that, as a result of the high refractive index of these materials (1.52, close to that of nitrocellulose itself), they impart outstanding brilliance, gloss and depth to lacquer compositions, which is of importance in paper lacquers, furniture finishes, and similar protective coatings for interior use.

Another property which indicates the value of these two liquid resins in furniture lacquers is shown to be their lack of crystallization at temperatures as low as —40° C., permitting the formulation of finishes with markedly increased resistance to cold-checking.

The booklet also indicates that the higher tolerance of nitrocellulose solutions for toluol solutions of Abalyn and Hercolyn may be helpful in formulating higher-solids lacquers. Since toluol solutions of either of these liquid resins can be incorporated in greater amounts than can ester-gum toluol solutions, without causing cotton precipitation, it is possible that they can be utilized to develop lower viscosity at equivalent fixed solids content.

In formulation and cooking of varnishes, Abalyn may prove useful due to its extreme resistance to alkali saponification, excellent wetting power for pigments, and ability to condense through its unsaturated double bonds with oil soluble resin-reactive phenolic resins, the booklet says. Preliminary experiments have shown that Hercolyn promotes the adhesion, flexibility and elongation of urea-formaldehyde resin films after baking.

The two materials added to water solutions of casein produce stable emulsions of increased flexibility and adhesion and the viscosity is increased in almost direct proportion to the amount of Hercolyn and Abalyn added.

The booklet gives data on ester content, refractive index, specific gravity, acid number, saponification number, color, viscosity, flash point, flame point, vapor pressure, boiling point, thiocyanate value, weight and specific rotation of the resins.

Tables and graphs of vapor pressure, thermal stability, and electrical characteristics and typical emulsion formulations are included.

Infra-Red Finishing Brochure

What is said to be the first brochure published on the subject of infra-red finishes is being distributed this month by Ault & Wiborg Corporation to manufacturers interested in the possibilities which infra-red finishing provides.

Also included is a series of questions and answers on infra-red finishing problems. The brochure is available to manufacturers who write to Ault & Wiborg, 75 Varick Street, New York City.

M & W not only supplies many kinds of lacquer, enamel, primer, and other finishing materials that the electro-plater needs, but also provides experienced technical assistance in their application.

In fact, M & W has been helping electro-platers solve their highly special finishing problems for more than 50 years, so our experience has covered a pretty wide range by now.

Whenever you need help — to get the best results — call on M & W. Our knowledge and facilities are freely at your service.

Maas and Waldstein Co. Newark, N. J.

Branch Offices and Warehouses . . . 1658 Carroll Ave., Chicago . . . 1228 W. Pico Blvd., Los Angeles

LACQUERS PIONEERS IN PROTECTION ENAMELS

NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Small Paint Circulating Systems

New small paint circulating systems, for finishing room use have just been announced by The De Vilbiss Company, of Toledo, Ohio.

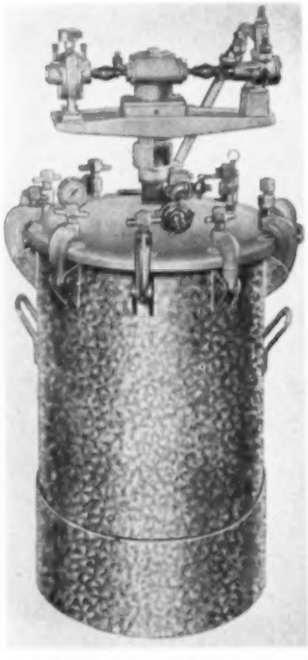
These systems are of special interest to the smaller manufacturer because they make available to him (for the first time at a cost well in keeping with relatively limited production) all of the economies, safety, and the convenience represented in the circulating system of paint delivery.

The new De Vilbiss Type QBM Small Circulating Systems will supply a maximum of six production-type spray guns in continuous operation, handling such materials as lacquers, synthetic enamels, paints, varnishes, shellacs, etc.

Heart of the new system is the tank assembly. The container is a standard Type QM unit (with agitator), 30 or 60 gallon capacity. The motor-speed reducer-pump combination, mounted compactly on a small platform on the lid of the tank, has been designed especially for this application. Either air or electric motors are available.

Both air and electric motors are of sufficient capacity to circulate fluids with a maximum viscosity of 25 seconds (determined on a No. 4 Ford cup) against an average loop pressure of 50 pounds per square inch.

The pump on the new De Vilbiss QBM Systems is the newly improved Type QB. It has no packing gland, incorporating, instead, a unique mechanical seal which insures much greater resistance to wear.



Small paint circulating tank.

Three QBM Systems are available. System "A" is the simplest in design and the least expensive to install. It delivers fluid over a loop no longer than 200 feet, with a minimum internal diameter of one-half inch. In this system, the material is forced throughout the loop by air pressure, while the pump is required merely to keep it in motion to prevent precipitation. Material enters the loop only as it is used and is not re-circulated through the tank.

With "B", the loop can be as long as 450 feet, with a minimum internal diameter of three-quarters of an inch. Included are individual fluid regulators for each gun, thus providing more accurate fluid pressure control than is possible with System "A". The material is kept more uniformly mixed by being constantly re-circulated through the tank by means of the pump which produces a pressure in excess of that in the tank.

With System "C", the fluid is re-circulated through the head of each gun, this is recommended for materials which are difficult to keep in suspension or which otherwise alter their physical characteristics when allowed to remain stationary for relatively short periods. With this system, individual fluid pressure regulators for every spray station are provided, as well as a relief valve at the beginning of the low pressure return side of the loop. Piping should be limited to a minimum internal diameter of one-half inch and a maximum length of 200 feet.

Plastic Coating for Metals

Marlox, a plastic coating for metals, is being introduced to the industrial market by Marley Chemical Co., 983 East Milwaukee, Detroit, Michigan. For protection against rust, corrosion and rot, it has long been known that certain plastics meet the most severe tests with regard to salt spray, humidity, acids and other attacks, so much so, that they almost approach the protective qualities of ceramics, without the disadvantages of these hard procelain enamels. This accounts for the wide use of plastics in industry today, where they are used for aeroplanes, propellers, radios, kitchen utensils, and even for teeth in dental plates.

Obviously, all plastics and plastic coatings are not the same—some are ornamental, and some are structural. Unlike most plastic coatings which are ornamental, but lack weather-resisting qualities, Marlox is a plastic coating of the structural type—used not as glamourtization, but rather for doing a tough job. This product is used either as a priming coat, or purely for protection against rust and corrosion.

Chief among many advantages claimed for Marlox is almost complete absence of porosity, as compared with coatings made from oils and pigments. Too, this product is said to exclude the air film present in such materials. Marlox is successfully applied by spraying, painting or dipping, forming a thin, flexible coating on any metal to which it is applied—so flexible that it is not affected to any noticeable degree by temperature changes. The same quality of flexibility, plus unusual adhesion, is said to make Marlox of particular value in coating welds. Here it is claimed to furnish adequate protection against corrosion and rust-creepage in the seams and folds, right up into the welded spot.

Zinc Chromate Production Primers, Fillers, Surfacers & Undercoats, Short High Bake Enamels, Chlorinated Rubber Enamels, Rapid Drying Synthetic Enamels, Lacquers and Enamels for all Surfaces, Wrinkle Enamels and Novelty Finishes.

H.V. WALKER CO.

MAKERS OF FINE FINISHES

ELIZABETH, N.J.

Marlox, used to inhibit rust and corrosion, is applied to a thickness of ½ of 1/10,000 of an inch. Used as a prime coat, it is applied to a thickness of 5/10,000 of an inch. Dilution with Solvesso is recommended, a gallon of finished mixture covering from 1,000 to 2,000 square feet of metal surface.

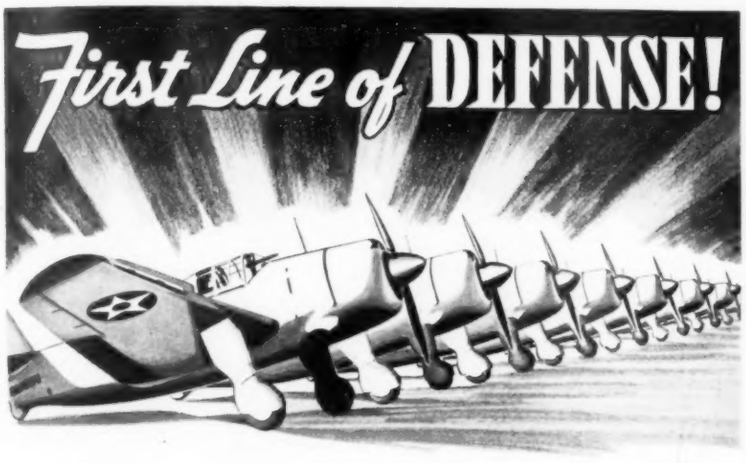
Tests by automotive manufacturers showed complete protection of Marlox-coated metal kept in a humidity chamber for six months, with average relative humidity of 98.5%, at a temperature of 94 degrees. A similarly coated panel was subjected to salt spray test for 600 hours and stood up perfectly.

Marlox dries quickly, and can be handled in five to ten minutes after applying. One hour's drying time is recommended where possible, before applying enamels or paints.

On close contact between metal and Marlox, a depolarizing action is set up by the slight water solubility of the pigment contained in this product. Corrosion is therefore actually retarded by electrochemical action, through electrolytic neutralization which renders the metal surface inactive, and consequently less susceptible to combination with oxygen, and therefore to formation of rust.

Marlox may be applied to all types of metals and alloys including steel, cast iron, aluminum, aluminum alloys, magnesium alloys, copper, brass, cadmium plate and galvanized or zinc coated steel. Marlox is also used to waterproof concrete.

Where weight is a factor, as in airplanes, it is interesting to note that use of Marlox is claimed to save 50% of the weight of the conventional primer.



THERE is a first line of defense for industry as well as for national safety . . . comparable lines in that they both stress PROTECTION. Just as a country depends on its armed forces to protect it from enemy invasion, so does the manufacturer depend on a finish to foil the invasion of rust, corrosion, tarnish and a host of elements which could destroy the product if it were not well protected.

EGYPTIAN FINISHES are being used as a first line of defense on more products today than at any time during their half century on the market. Standard Lacquers and Synthetics as well as a host of special finishes for individual requirements are doing their bit to protect and beautify thousands of industrial items.

We will be glad to tell you more about the EGYPTIAN "first line of defense" and how it can help *your* product.

THE EGYPTIAN LACQUER MANUFACTURING CO.
ROCKEFELLER CENTER NEW YORK

EGYPTIAN FINISHES

EGYPTIAN Superior FINISHES

DeVilbiss Co. Expands

The DeVilbiss Company, manufacturer of spray painting equipment, recently announced the addition of 50,000 square feet of manufacturing space to its facilities in Toledo, Ohio.

The additional space is located at 397 Phillips Avenue, in close proximity to the company's main office and factory buildings. One-hundred fifty workers have been assigned to the new quarters.

Need for this expansion is due largely to the demand for the company's products in all branches of industry engaged in National Defense work.

The company's products—spray painting equipment, air compressor, hose, etc.—find broad application throughout the defense industries, and are at present being used in the construction and production of everything from cantonments to shells.

The Logan Engineering Company, Chicago, makers of Aridifier air and gas cleaners, advises that *J. A. McCoy*, 1436 41st Place, Des Moines, Iowa, is now representing them in the entire State of Iowa.

Mr. McCoy, an old-timer in engineering selling, has been serving Iowa industrials for more than twenty years with recognized lines of industrial equipment and is well known in metal working plants.

Manufacturers' Literature

Corrosion Resistant Paint

Corrosion Resistant Paint. Bulletin No. 1612 issued by U. S. Stoneware Co., 60 E. 42nd Street, New York City, describes a new corrosion resistant paint which is stated to withstand the action of almost all acids, salts and alkalies, including nitric and chromic acids. It is recommended for use in laboratories, plating rooms and wherever corrosive conditions must be withstood.

Infra-Red Heat Lamps

Wabash Appliance Corp., 331 Carroll St., Brooklyn, N. Y., have issued their bulletin No. 121B, which gives general information on the subject and application of infra-red heat lamps. The bulletin gives information on how the lamps work, and describes the type of rays involved for the drying of lacquers and enamels. The advantages and application features of infra-red drying are also described. Photographs illustrate uses of infra-red lamps for drying of finishes.

Spray Finishing Equipment

Spray Finishing Equipment. The DeVilbiss Co., Toledo, Ohio, have issued their catalog "IE", which devotes 28 pages to the description of the company's equipment for spray finishing. This equipment includes spray guns, feed cups, feed tanks and mixing equipment, paint circulating systems, hose, respirators, spray booths, air compressors and other auxiliary equipment. Prices are also given for the various equipment described.

How the Performance of **ONE** Mahon Oven Sold **TWO MORE** to the Same Manufacturer

In 1939, The Stout Sign Company, of St. Louis, Mo., sought a speedier and more economical means of drying the finish on their product. Following a thorough analysis of their problem, Mahon engineers installed a Mahon Gas-Fired, Box-Type Oven, with a temperature range up to 400° F. The oven was designed to re-circulate heated air and to exhaust volatile gases and was fitted with automatic safety and temperature controls.

A close check was kept of the service and savings effected. So well did the performance record show up, two similar Mahon ovens now have been added to the finishing line in their fine, new, modern plant, recently completed.

If YOU have a drying or baking problem, Mahon experts will advise you just as carefully in regard to the size and type of oven and equipment which will operate most efficiently and economically for YOUR PRODUCT.

THE R. C. MAHON COMPANY • DETROIT • CHICAGO

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Drying and Baking Ovens, Dust Collectors, Filtered Air Supply Systems and Many Other Units of Special Production Equipment.

MAHON

METAL FINISHING

REPARATION, ELECTROPLATING, COATING

ISHED FOR THIRTY-SEVEN YEARS AS METAL INDUSTRY

JUL 11 1941

LEA
FINISHING ENGINEERS

THIS IS IMPORTANT!

Because of certain shortages, will you be obliged to change the design of your product or adopt different fabricating materials in order to hold your market?

If you must change, will your present finishing methods apply?

If ever a broad experience in the technique of finishing articles is coming in handy, it is right now with the whole manufacturing industry—metallic and non-metallic — being forced to completely re-orient itself as to design of products and materials of which they are made.

Finishing methods cannot possibly escape this impact of emergency.

So what's your situation? Can our finishing engineers be of service? Don't forget they have many years of experience back of them with over 100 different kinds and grades of polishing materials with which to work out a new method for you.

THE LEA MFG. CO., Waterbury, Conn.

Specialists in the Production of Clean-Working Buffing and Polishing Compounds

Our Sentinels of the Skies

REQUIRE NEW AND IMPROVED CLEANING COMPOUNDS

The Frederick Gumm Chemical Company is proudly contributing to the program of National Defense by having achieved an outstanding new chemical compound especially prepared for the cleaning of aluminum parts used in the construction of airplanes.

The CLEPO monogram is a symbol of dependability. Every compound bearing the CLEPO label represents the highest standard of chemical research and achievement.

E
L P
CLEANING COMPOUNDS
C O

FREDERICK GUMM CHEMICAL COMPANY, Inc.

538-542 FOREST ST., KEARNY, N. J.

PLATING AND POLISHING EQUIPMENT AND SUPPLIES

Western Distributor: BELKE MFG. CO., 947 N. Cicero Ave., Chicago, Ill.

Founded as METAL INDUSTRY, January, 1903 by
PALMER H. LANGDON
1868-1935

METAL FINISHING

VOLUME 39 JULY, 1941 NUMBER 7

Publication Office:
116 John Street, New York

L. H. LANGDON
Publisher

THOMAS A. TRUMBOUR
Business Manager

DR. WALTER R. MEYER
Editor

PALMER H. LANGDON
Assistant Editor

JOAN TRUMBOUR
Advertising Manager

PUBLISHED MONTHLY—Copyright 1941 by The Metal Industry Publishing Company, Incorporated, 116 John St., New York, N. Y. Entered February 25, 1903, at New York, N. Y., as second class matter under Act of Congress, March 3, 1879. Re-entered as second class matter June 13, 1940, at the post office at New York, N. Y., under the Act of March 3, 1879.

SUBSCRIPTION PRICES: United States, $2.00 per year; Canada, $2.50 per year (includes 50c exchange and tax). Foreign $5.00. Single copies 25c. Please remit by check or money order; cash should be registered.

ADVERTISING RATES on application. Forms close the first of the month. Advertising copy should be mailed in time to reach us on or before the 20th of the preceding month.

METAL FINISHING reserves the right to investigate all products offered for advertisement, to refuse advertising considered unsuitable and to edit advertising copy when necessary.

CONTENTS

Editorial 351

Convention of American Electroplaters' Society 352

The Corronizing Process of Metal Coating—By Richard Rimbach 360

X-ray Measurement of Silver Plating Thickness—By Robert C. Woods 365

Effects of Impurities in Plating Solutions—By Dr. Walter R. Meyer 369

Organic Finishing Section 395-410

DEPARTMENTS

Principles of Science Relating to Electroplating 373
Shop Problems 376
New Equipment and Supplies 377
Manufacturers' Literature 381
New Books 332
Technical Publications 383
Associations and Societies 384
Obituaries 385
Personals 386
Business Items 388
Patent Digest 339
Supply Prices 393
Post Scripts 40

METAL FINISHING (formerly Metal Industry) has been the leading publication since 1903 in the field of metal preparation, electroplating and coating.

WHY ASK THE INDULGENCE OF YOUR CUSTOMERS?

Prepare For The Continuity Of Service By Taking Advantage Of The Ample Supply Of

HARRISON'S POLISHING COMPOUNDS

Faster—More Efficient—Better Finish—Uniformity

4A symbolizes these four features which you require for high speed polishing, mirror finishing of all kinds of steel, including stainless steel, carbon steels and hard-to-buff alloys. Use it on any kind of a wheel, soft, medium or hard.

CEMENT AND THINNER

NO WORRY ABOUT GLUE SHORTAGE WITH 4A CEMENT AND THINNER. Polishing wheels are free cutting, long lasting and economical when set up with 4A Cement.

Tell us your problem and samples of compound or cement will be sent.

HARRISON and COMPANY

Haverhill, Mass.

ADEQUATE RESERVES READY FOR PROMPT SHIPMENT

VOL. 39, NO. 7 METAL FINISHING JULY, 1941
PREPARATION, ELECTROPLATING, COATING

Chromic Acid Contamination of Plating Solutions

A frequent trouble met with in plating is contamination of plating solutions from chromic acid. The usual mode of entry is drag-in on plating racks, particularly when the insulating coating on the rack is loose. Cases have even been observed where chromic acid in a cyanide dip preceding plating caused extensive peeling of the subsequently zinc plated steel. Some of the characteristics of chromium contamination are blistering or peeling of the deposits, poor coverage, and reduction of cathode efficiency. In fact, chromic acid can reduce the efficiency of nickel plating solutions or cyanide plating solutions to zero. As little as 0.002 oz./gal. in a cyanide copper strike has been shown to affect the distribution of copper plate, and as little as 0.03 oz./gal of chromic acid will prevent deposition of the zinc.

Dr. M. M. Beckwith of the J. B. Ford Sales Company, Wyandotte, Mich., studied the problem and realized that the solution involved the reduction of the hexavalent chromium to trivalent chromium. He found that a suitable reducing agent is sodium hydrosulfite, $Na_2S_2O_4$. By the use of this reagent, the hexavalent chromium is reduced to trivalent chromium and for copper plating solutions, in the absence of Rochelle salts, the chromium hydroxide can be filtered out. The other product formed is sodium sulfite, which is harmless to most plating solutions. In cases where Rochelle salts are present, the trivalent chromium forms a complex with the tartrate. Quantities from 0.05 to 0.08 g/l of sodium hydrosulfite are usually sufficient for returning the solution to normal. Larger quantities, however, do not seem to have a detrimental effect and in case an excess is added, this can be destroyed with hydrogen peroxide. It is interesting to note that the copper deposits from solutions treated with sodium hydrosulfite are considerably brighter than those deposits from untreated solutions.

The Awards Committee of the American Electroplaters' Society justly awarded Dr. Beckwith the Herminie Proctor Memorial Award for his paper which was presented at the annual convention of the Society held recently in Boston.

Magnesium Metal from the Sea

The sea contains an almost inexhaustible supply of metals, such as magnesium, copper and gold, but unfortunately, concentrations of most metals in the sea are so low that the cost of extraction is prohibitive in comparison with the cost of refining from ores occurring in the earth.

In 1915 magnesium was begun to be extracted from Michigan brines and the Dow Chemical Company has recently announced an outstanding chemical engineering achievement, namely, production of magnesium metal from the sea in commercial quantities. The company started production of magnesium on January 21st at its Freeport, Texas plant. This achievement is particularly important in view of the strategic importance of magnesium in airplane production.

The Zinc Situation

The Division of Priorities has announced that the amount of metallic zinc to be set aside in July, in an emergency pool, will equal 22% of May production, or approximately 16,000 tons.

Zinc was put under full priority control in an order issued on June 10th, and this order provided that emergency pools would be created, out of which allocations could be made to meet urgent needs. Present figures indicate an over-all shortage of zinc of from 215,000 to 275,000 tons for the year 1941.

Congratulations Boston Branch A. E. S.

For almost a year, Joe Barron and committee had been telling the electroplating industry of the excellent program arranged for the annual A.E.S. convention. We are happy to state that these claims were justified.

The fact that it was the largest convention in history with 721 registrants was only one of the reasons for its success. The outstanding dinner and show, the balanced and well run educational program, the extensive and well shown plating exhibits, the excellent hotel facilities and other factors all contributed to the meeting's success. All this was made possible by the sincere efforts of every member of the committee. Our thanks go to them for a job well done.

29th Annual A.E.S. Convention at Boston Most Successful Meeting Ever Held

BY DR. WALTER R. MEYER

Editor

The 29th Annual Meeting of the American Electroplaters' Society, held at Boston, Mass., on June 9-12 was undeniably the most successful convention ever held by the Society. A new attendance record was set with 721 registrants. In spite of the large attendance, however, every detail was taken care of smoothly including registration, educational sessions, plant visits and entertainment. The Exhibits Committee, headed by *Arthur J. Mintie*, did an excellent job and two large rooms were available for showing the many exhibits from various branches of the Society. These rooms were situated adjacent to the registration desk and to the general meeting room and thus were readily accessible.

The educational sessions were very well attended from the first paper to the last, and the papers were presented under close timing allowances, and the discussions were capably handled by the chairmen. Congratulations of the Society should go to *Joe Barron*, General Chairman; *Ann Baker*, General Chairlady, and to every member of the Committee. The sessions closed Thursday evening with an attendance of over 1200 people at the dinner, stage show and dance. Careful planning of seating arrangements eliminated confusion, and prize award announcements were efficiently made from the speakers' table. The Entertainment Committee, headed by *Louis Tosi*, presented a stage show unparalleled in the history of the Society: in fact, the continual applause of the audience extended the acts so long that part of the dancing time was consumed by the show. At the close of the program, expressions of approval were heard on every hand.

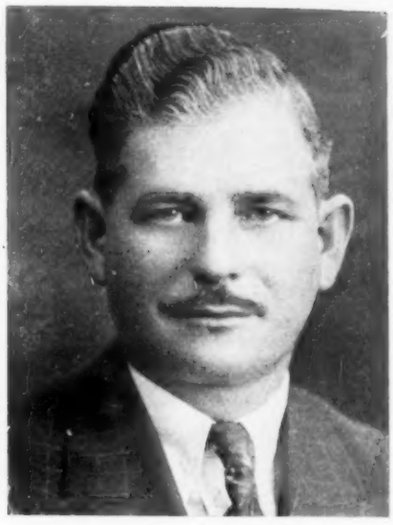
Early Arrivals

As early as Saturday evening, some of the regular attendants at these annual meetings began to arrive and by Sunday afternoon, the Statler Hotel lobby was filled with A.E.S. members, and their wives, greeting each other. By Monday evening it was evident that the attendance at the meeting would be the largest in the Society's history.

Monday

Mayor *Morris J. Tobin* was unable to be present at the opening session on Monday morning, but he later addressed the mem-

Ellsworth Candee
Supreme President



George Wagner
Supreme 2nd Vice-President.

Charles C. Conley
Supreme 1st Vice-President.

Maurice R. Caldwell
Supreme 3rd Vice-President.

A portion of conventionites. We haven't room to name everybody present, but a few of the A.E.S. notables shown are, reading left to right, George Wagner, Bill Seidel, George Klink, Jack Geissman, Lou Hague, Bill Chace, Lou Gale, Arthur Mintie, Oscar Servis, Charles Conley, Ellsworth Candee, Dick Crane, Bill Kennedy, Ed Jarms, Joe Downs, Horace Smith, Stan Harris, Bill Maguire, Sylvester Gartland, H. A. Gilbertson, Paul Strausser, Phil Prouty, Ed Luther, Adolph Grele, Ted Eichstaedt, Doc Garner, Ray Goodsell, Oscar Stocker, Cyril Kocour, Joe Sterling and Nelson Sievering. The lady crouching and wearing tropical helmet is Mrs. Tom Chamberlain.

bers at the Open House meeting held Monday evening. *Joe Barron*, General Chairman, welcomed the members, delegates and visitors to the meeting and following this, *William Jones*, President of the Boston Branch, addressed the group. *Frederick Fulforth* then presented his presidential address and various items of business were taken care of. A feature of the Monday morning meeting was an address by *Dr. Samuel Stratton* of the O.P.M. office in Washington, who spoke on the critical metal situation and outlined prospects of the future in regard to metals. The meeting room was packed to hear the important words of Dr. Stratton.

On Monday afternoon, the first Educational Session was held with *John E. Costigan* of the Springfield Branch, presiding. *Dr. Wm. Blum* of the Bureau of Standards, Washington, D. C., was the first speaker and he did not present a paper on salt spray as originally scheduled. He discussed a more important subject of the moment, namely, the critical metal situation. He outlined various suggestions as to substitutes and ways of minimizing the consumption of certain strategic metals.

Papers were then presented by *Albert Hirsch*, Snyder, Inc., Philadelphia, Pa.; *C. P. McHugh*, Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.; *Dr. H. H. Uhlig*, General Electric Co., Schenectady, N. Y., and *Dr. Allen G. Gray*, E. I. duPont de Nemours & Co., Inc., Cleveland, Ohio.

On Monday evening, the Open House of the International Fellowship Club was held in the Grand Ball Room at the Hotel Bradford. This party was a decided success as was evident by the large number of people staying until the very end of the dance. A buffet lunch was served at 10:00 P.M.

Tuesday

Tuesday morning, the second Educational Session was held with *P. R. Lyons*, of the Cleveland Branch, presiding. Papers were presented by *Dr. Abner Brenner*, National Bureau of Standards, Washington, D. C.; *Dr. J. E. Stareck*, United Chromium, Inc., New York; *James E. Dowd*, The Conde Nast Engravers, Inc., Greenwich, Conn., and *Gerald A. Lux*, Research Associate, A.E.S., Washington, D. C.

Promptly at 12:00 noon, buses took the men registrants to the *Whiting & Davis Company*, Plainville, Mass., where a luncheon was served through the courtesy of *Frederick Gumm Chemical Company*, Kearny, N. J. Following the luncheon, the trip took place through the plant where members saw the various stages in the manufacture of ladies' mesh bags, starting with the raw sheet and ending with the finished bag. The method of making the mesh was of particular interest.

At 3:00 P.M., buses then took the men to the *Warren Telechron Company*, Ashland, Mass., where the assembly operations in the manufacture of clocks were seen as well as a modern plating room. Members were returned to the hotel by bus in time for the evening educational session at which *Wm. M. Phillips*, General Motors Corp., Detroit Branch, presided. The Tuesday evening session featured a "Symposium on Impurities in Plating Solutions." Speakers who took part in this Symposium were: *Dr. Walter R. Meyer*, METAL FINISHING, New York; *Walter A. Helbig*, Darco Corp., New York; *O. A. Stocker*, Rufert Chemical Co. Div. of

New Honorary Members

Ernest Lamoureux

George Gehling

A second portion of conventionites. Left to right, include: Gene Phillips, Jim Hanlon, John Oberender, Bob Leather, Charles Hendershott, Walter Helbig, J. T. Rooney, Phil Ritzenthaler, Maurice Caldwell, Lyman Sperry, Dan Wittig, John Merigold, Wilfred S. McKeon, Prof. H. R. Hanley, George Loeser, Roman Binder, Bill Baulieu, Lou Donroe, Derick Hartshorn, Bill Ehrencrona, Bert Sage, Arthur Pierdon, George Knecht, Frank Savage, Austin Fletcher, Bill Jones, Bob Goodsell, Walter Larrson, Jack Dimon, Dave Clarin, George Simmons, Fred Fulforth, Doc Kellner, Seth Marland, Bob Green, Wes Cassell, Charles McElroy, John Feeley.

Seymour Mfg. Co., Seymour, Conn., and *Dr. M. M. Beckwith*, J. B. Ford Sales Co., Wyandotte, Mich. In addition, a paper on "Throwing Power of Plating Solutions" was presented by *George B. Hogaboom*, Hanson-Van Winkle-Munning Co., Matawan, N. J., and a paper on "Electroplating Education" was delivered by *Dr. C. B. F. Young*.

Wednesday

Wednesday, buses took the members, in the morning, on a tour of historical places in the vicinity of Boston, including historic Plymouth and Pilgrim shore. Their final destination was the Pemberton Inn, Hull, Mass., where a lobster dinner was served. An orchestra provided music for dancing. After dinner, the members strolled about the grounds renewing acquaintances, discussing problems or taking part in various sports, such as the East vs. West baseball game and horseshoe pitching. The titanic baseball struggle between the East and West was won by the East.

The winning East team was captained by *Dr. C. B. F. Young* and the West team by co-captains *Rudy Hazucha* and *Frank Savage*. *Dave X. Clarin* acted as umpire and was wounded once in the fray.

After the afternoon of sports, the attendants were returned to the hotel by bus, and in the evening the fourth educational session was held with *Dr. Walter R. Meyer*, Bridgeport Branch presiding. Speakers at this session were: *Gustave Klinkenstein*, Maas & Waldstein Co., Newark, N. J.; *F. F. Oplinger*, E. I. du Pont de Nemours & Co., Wilmington, Del.; *Dr. C. L. Faust* and *Dr. H. Pray*, Battelle Memorial Institute, Columbus, Ohio, and *T. G. Coyle*, United Chromium., Inc., New York. The paper by *E. H. Lyons, Jr.*, was carried over until Thursday morning.

Thursday

On Thursday, the fifth and last educational session started promptly at 9:00 A.M., at which time papers were read by *E. H. Lyons, Jr.*, The Meaker Co., Chicago, Ill.; *I. Albert Lee*, General Electric Co., Bridgeport, Conn.; *M. F. Maher, Jr.*, Etched Products Corp., L. I. City, N. Y. The concluding paper was a discussion by *Prof. W. J. Conley* of the University of Rochester on various metallurgical aspects of metals that have a bearing on plating problems. The paper scheduled to be presented by *Harold M. Lang*, Sigmund Cohn, New York, was not given.

Final Business Session

New Officers

At the final business session, officers for the year 1941-1942 were elected. *Ellsworth Candee*, American Brass Co., Waterbury, Conn., was elected supreme president; *Chas. C. Conley*, Stolle Corp., Sydney, Ohio, was elected first vice-president; *George Wagner*, Hy-Grade Electroplating Co., New-

Dr. M. M. Beckwith
Winner of Proctor Award.

B. F. Lewis
Winner of Founders' Gold Medal.

The remaining portion of conventionites. Left to right: Al Hirsch, Jerry DeGrazia, LeVerne Verzier, Tom Slattery, Arthur Collins, Homer Morton, Henry Mahlstedt, Bill Scott, George Hogaboom, Frank Mesl:, Art Logozzo, Joseph Singler, Ralph McCahan, Dr. Wm. Blum, Dr. George Dubpernell, H. F. McFall, Gerald A. Lux, Joe McConas, Joe Sullivan, Louis Lougee, M. H. Longfield, Joe Barron, F. L. Clifton, George Wagner's half-brother Stanislaus Wagner; Vladivostok Geissman, half-brother of Jack Geissman; Ivanovitch Klink, twin brother of George Klink, all shown on page 353, and R. J. Morrow.

ark, N. J., was elected second vice-president, and *Maurice R. Caldwell*, W. B. Jarvis Co., Grand Rapids, Mich., was elected third vice-president.

1942 Convention City

There was considerable interest and discussion over the selection of the convention city for 1942. Requests for conventions for following years were also made. Representatives from Toronto, Los Angeles, Cleveland, Buffalo, Grand Rapids and Chicago, all made requests for future conventions. The race for the 1942 convention was between Buffalo, Grand Rapids and Cleveland, with the final vote being as follows:

Grand Rapids—54
Buffalo—18
Cleveland—18

New Honorary Members

Two new honorary members were elected to the Society; these were *George Gehling*, Frederick Gumm Chemical Co., who resides in Philadelphia, Pa., and *Ernest Lamoureux*, now retired, of Los Angeles.

Prize Awards

The Awards Committee with *Maurice R. Caldwell*, as Chairman, announced the following awards:

HERMINIE DOROTHEA PROCTOR AWARD OF $100

Winner
Dr. M. M. Beckwith
J. B. Ford Sales Co., Wyandotte, Mich.
Subject: "Removal of Chromium Contamination in Alkaline Plating Solutions".
Honorable Mention
Ernest H. Lyons, Jr.
Dr. Charles L. Faust
Dr. Abner Brenner
Dr. Allen G. Gray

FOUNDERS GOLD MEDAL

Winner
B. F. Lewis
Technical Director, Northwest Chemical Co., Detroit, Mich.
Subject: "The Relationship of Cleaning Techniques and Adhesion of Electrodeposits".

A.E.S. GOLD MEDAL

Winner
Walter L. Pinner
Chemical Engineer, Houdaille-Hershey Corp., Detroit.
Subject: "A Short Research on the Effect of Basis Metal Polishing on the Character of Nickel Plate".

$50. PRIZE FOR BEST PAPER OF YEAR IN MONTHLY REVIEW

Winner
Robert M. Wagner
Guide Lamp Div., General Motors Corp., Anderson, Ind.
Subject: "National Defense and the Electroplating Industry".

Walter L. Pinner
Winner of A.E.S. Gold Medal.

Arthur Logozzo
First Certificate of Exhibits Award.

Plating Exhibit Awards

Metal Finishing Cup
Chicago Branch
First Certificate Award
Arthur Logozzo
Springfield Branch
Second Certificate Award
Arthur J. Mintie
Boston Branch
Third Certificate Award
Clarence Robinson
Grand Rapids Branch
Samuel Huenerfauth Cup
Toledo Branch for the paper entitled, "The Relative Effect of Various Polishing Finishes on Corrosion Resistance of Electroplated Nickel Deposits on Steel".

Dick Crane
Chairman, Int. Fellowship Club.

Charles Schlott
1st vice chairman; Int. Fellowship Club.

Wm. M. Cole
2nd vice chairman,
Int. Fellowship Club.

International Fellowship Club

The Club took an active part in the 29th annual meeting. It sponsored the highly successful Open House, held Monday evening. A golf tournament was held on Wednesday afternoon and a Wednesday afternoon ladies' party.

At the annual luncheon of the Club, held Monday noon, *Dave X. Clarin*, Oakite Products, Inc., New York, presided, and 91 members were present. A report was presented by the Permanent Secretary, *Thomas A. Trumbour*, and various business items were transacted. *Dick Crane*, Lea Mfg. Co., Waterbury, Conn., was elected Chairman for 1941-42; *Charles Schlott*, Egyptian Lacquer Mfg. Co., New York, was elected first Vice Chairman and *Wm. M. Cole*, J. B. Ford Sales Co., Wyandotte, Mich., was elected second Vice Chairman.

ABSTRACTS OF TECHNICAL PAPERS

Advantages and Objections to the Salt Spray Test from an Electroplating Point of View

By Albert Hirsch

Snyder, Inc.
Philadelphia, Pa.

Some of the inconsistencies of salt spray testing were outlined. Some of the advantages discussed for salt spray testing are:

1. A comparison can be made of thin and thick deposits either on the same or separate pieces of work.
2. Organic finishes can be tested.
3. Different types of finishing techniques can be compared.

Some of the disadvantages of the salt spray test are:

1. There is no complete correlation between salt spray tests and outdoor exposure, particularly for zinc and cadmium.
2. The test is particularly sensitive to physical conditions, such as temperature, air pressure, method of hanging the work.

Various workers, including Baker, Pinner and Phillips, have shown that the porosity of nickel coatings is dependent upon such factors as polishing of the base metal and the presence of solid matter. Thickness measurements alone, therefore, would not give a proper measure of the degree of corrosion resistance of nickel coatings, and thus the salt spray test is valuable for evaluating porosity.

It was pointed out by Mr. Hogaboom that one of the difficulties in obtaining uniform results in salt spray testing is improper wetting of the surface by the spray.

An Educational Program for Everyone

By the Rochester Branch
American Electroplaters' Society

This paper consisted in a presentation by *W. J. Conley*, Professor of Applied Mechanics, University of Rochester, Rochester, N. Y., of various aspects of fundamental metallurgy and their relation to the practical application of alloys. The formation of crystals and various types of solid solutions and compounds were illustrated.

A group of slides strikingly illustrated the non-homogeneity of various metal surfaces and the effects of non-homogeneity on electrodeposits formed thereupon, were indicated.

The Contamination and Cleaning of Cold Rolled Steel

By Ernest H. Lyons, Jr.
Chemist, The Meaker Company

The cold rolling of steel avoids the formation of scale and produces a high finish very advantageous for electroplating, but the coolant oils used may so contaminate the steel that cleaning it before plating becomes quite difficult. The contaminants are of two types: (1) strongly adsorbed compounds, some of which can hardly be removed without attacking the underlying metal; (2) tarry residues from the breakdown of the oil during rolling. The first type of contamination occurs when palm oil is used; the adsorbed compounds are fatty acids or similar materials. Such compounds are now being marketed in anti-rust oils. In cleaning steel so coated, a moderate alkali content, high temperature (200-210° F.), and high current density (100 amps./sq. ft.) are recommended. When mineral or soluble oils are employed, the temperatures and pressures of rolling may cause cracking or decomposition of the oil, much as in an automobile motor. The residues are often insoluble in organic solvents, and may appear to be baked on like a lacquer. Breakdown of oils may be observed in laboratory experiments as well as at the mills, and is accompanied by changes in pH.

Details of the rolling process were considered to show how the contamination may occur, and thorough wiping after rolling was recommended. For cleaning such steel, very high alkali concentrations (8-12 oz./gal.) and high current densities (100-125 amps./sq. ft.) are suggested; temperature seems less important. Commercial cleaning prep-

arations have advantages for both cases. Electrolytic cleaning sequences which remove soils in less than three seconds preparatory to hot dip tinning were described. For extremely dirty steel, the following measures were suggested: burning off the oils; Taimon process cleaning in fused caustic soda; the use of preliminary soaks in kerosene or emulsion solvents, taking precautions against recontamination from these materials; the addition of zinc or copper to the alkaline electrolyte; and anodic cleaning at 100-150 amps./sq. ft. in 5-30% sulfuric acid, alternated with alkaline cleaning. However, the condition of the steel is the most important factor, and it is suggested that operators of rolling mills pay more attention to cleanliness, particularly when mills are speeded up in connection with defense production.

Modern Methods of Copper Plating

By Floyd F. Oplinger

Assistant Manager, Electroplating Div., E. I. duPont de Nemours & Co., Inc., Wilmington, Del.

The historical aspects of copper plating were first discussed. A vast increase in copper plating has resulted from the nickel shortage with trend to much heavier copper plates with lighter nickel coatings.

The practice of polishing work, Rochelle salt copper plating, bright nickel and chromium plating, is being superseded by the following system, particularly for steel.

1. No pre-polishing
2. Heavy copper plate (up to 0.002")
3. Buff
4. Light copper plate
5. Bright nickel
6. Chromium plate

This method was stated to give excellent corrosion resistance to the base steel possibly because of the closing of pores of the heavy copper deposit.

Unichrome Copper

By T. G. Coyle

Technical Director United Chromium, Inc., New York

The author described a new non-cyanide plating solution developed by United Chromium, Inc., New York. In this bath, the copper is present in the cupric state in concentrations from 3 to 5 oz./gal. together with a large amount of pyrophosphate, 20-40 oz./gal. A small amount of ammonia is added and the recommended pH range is from 8.3 to 8.5. However, the bath is stated to be operable from 7.5 to 9.0 pH.

The deposits produced are stated to be fine grained, easily buffed and to be capable of being oxidized and etched. Throwing power is claimed to be excellent and anode and cathode efficiencies of the order of 100%. The bath is stated to obviate spotting out difficulties, is non-corrosive to tanks and rack coatings, has good impurity tolerance and can be completely analyzed. Rolled electrolytic or cast copper anodes are suitable. Current densities from 20 to 40 amperes per sq. ft. can be employed at a bath temperature range from 100 to 140° F. When plating upon steel or zinc, a preliminary copper strike from a cyanide solution is recommended to insure good adherence.

Cathode Films in Electrodeposition

By Dr. Abner Brenner

Chemist, National Bureau of Standards Washington, D. C.

The freezing and the drainage methods, with some refinements were used to study the composition of cathode films formed during electrodeposition. At 25° C. the thickness of the film is about $0.010'' \pm 0.002''$ in unstirred baths. The film is completely formed in about 2 minutes after the start of electrolysis, but it dissipates somewhat more slowly after the circuit is broken. The changes in composition of the solution at the cathode produced by electrolysis under various conditions in typical plating baths were determined. Most of these results can be explained qualitatively by simple theoretical considerations.

Effects of Impurities in Plating Solutions

By Dr. Walter R. Meyer

Editor, Metal Finishing New York

The author first discusses the methods by which impurities enter plating solutions. Some of the methods of entry are as impurities in plating salts and anodes, from water, drippings from bus bars, conveyor equipment, parts falling into the plating tank and drag-in on plating racks.

The impurities are classed into two groups, namely, organic impurities and inorganic impurities. The detection of impurities by means of the Hull cell or the bent cathode test is described. Specific effects of impurities in both acid and cyanide copper plating solutions, nickel plating solutions, cadmium plating solutions and zinc plating solutions, are described.

Electrolytic Polishing of Stainless Steel

By Dr. H. H. Uhlig

Research Laboratory, General Electric Co., Schenectady, N. Y.

The use of glycerine-phosphoric acid mixtures for electrolytically polishing 18-8 stainless steel was described. Optimum conditions to produce polish were determined with the aid of a photoelectric spectrophotometer. Maximum polish is obtained with an electrolyte consisting of approximately 42% H_3PO_4, 47% glycerine and 11% water by weight, used at 100° C. or higher and anode current density of at least 0.1 amp./sq. in. (1.5 amp./dm.^{2}). Other organic additions to phosphoric acid likewise produce practical electrolytes. These substances consist, in general, of high boiling materials soluble in phosphoric acid containing one or more hydroxyl groups. Nickel, copper, chrome steels, 18-8 containing molybdenum, and mild steel, similar to 18-8 can also be polished in these organic solution-phosphoric acid electrolytes. Organic additions to phosphoric acid affect electrolytic polishing apparently by two independent mechanisms. The first is a change in electrolyte and anode phosphate film conductivity to produce optimum polish, and the second is a considerable retardation of localized pickling of the anode by acid independent of anodic solution. Stainless steel is much easier to polish electrolytically than iron.

Physical Removal of Impurities from Plating Solutions

By Walter A. Helbig

Chemical Engineer, Darco Corp., New York, N. Y.

This was a comprehensive paper covering almost all aspects of mechanical removal of impurities by filtration. The construction of filters together with various pertinent information for the proper operation of filters was given.

The second portion of the paper discussed removal of impurities by adsorption. The types of impurities removable by this method were first discussed. Various factors attendant with the periodic treatment of activated carbon were then outlined. Following this, continuous treatment with activated carbon was discussed in detail. Data were also given on actual extent of removal of surface active materials by activated carbon. It was shown that by proper selection of concentration of surface active material and dose of carbon used, it is possible to employ continuous purification without removal of sufficient wetting agent to cause difficulty.

The Uses and Limitations of Radiant Heat for Baking Organic Finishes

By Gustave Klinkenstein

Vice-President, Maas & Waldstein Co., Newark, N. J.

The advantages and disadvantages of the radiant-heat process of baking organic finishes were discussed from the standpoint of the finisher. Radiant heat baking is best suited for finishing large quantities of single, or similar products and it is not well adapted for the use of manufacturers who must bake many different kinds of products at the same time, or who are constantly changing the character of their products. The process is a rapid one but it is economical only when the baking equipment is specifically designed for the work it is to do; if much of the energy radiated by the heating lamps is wasted, the cost of current may become prohibitive.

The finishing material used must also be selected with special care in order to take full advantage of the speed and other features of the baking process; to use a finish that bakes slowly means both a decrease in production and an increase in cost of finishing each unit. A special problem arises due to the fact that black finishes bake more quickly under radiant heat than do white finishes of the same general composition, with other colors occupying intermedi-

ate positions. This means that, for a given radiant-heat installation, finishes of different colors must be so formulated that all will bake properly in the same time; otherwise, the baking equipment will have to be changed to suit each color. Similarly, products made of sheet metal bake more quickly than do those made of solid metal, and if both kinds of products are to be baked in the same oven, the baking qualities of the finish used on each kind must be carefully adjusted to the conditions.

When a radiant-heat baking oven is being installed, and also when the product or the finish to be baked in it is to be changed, the finish manufacturer should always be consulted in order to secure maximum operating efficiency.

The advantages of radiant-heat baking, where applicable, were summed up by Mr. Klinkenstein as follows: quick baking, especially suited to high-speed mass production, low installation and maintenance costs, ease and flexibility of installation, small space required, comfortable working conditions, and high degree of fire safety.

The Removal of Chromium Contamination from Alkaline Plating Solutions

By M. M. Beckwith

The J. B. Ford Sales Co., Wyandotte, Mich.

An impurity causing considerable trouble in copper plating solutions is hexavalent chromium. It has been shown that as little as 0.075 g./l. will reduce the cathode efficiency to less than 2%. The author found that chromic acid present in copper cyanide strike solutions could cause blistering of subsequently deposited copper and even small quantities could cause dulling of the plate and inferior throwing power. A search for a suitable reducing acid was made and it was found that sodium hydrosulfite, $Na_2S_2O_4$ was found to be suitable. In the reduction, sodium sulfite and trivalent chromium are formed. If Rochelle salts are present in the bath, the hexavalent chromium will be reduced to trivalent chromium which then forms a complex with the tartrate. When no Rochelle salts are present, the precipitated chromium hydroxide can be filtered out. Sodium hydrosulfite can also be used to precipitate lead from a copper plating solution. As little as 0.05-0.075 g./l. of sodium hydrosulfite is usually sufficient for returning the solution to normal. Quantities up to ½ g./l. have been used commercially, and up to 8 g./l. have been used in experimental tests without any noticeable difficulty. An excess of hydrosulfite can be destroyed with hydrogen peroxide.

Sodium hydrosulfite can also be used for the removal of chromium from zinc and cadmium cyanide plating solutions.

Electrocolor and Patternplate

By Dr. J. E. Stareck

United Chromium, Inc., New York

The process of depositing colored films upon metals was discussed in detail. It consists of reducing copper from the cupric state in solution to cuprous oxide which is deposited upon the work. Current densities from ¼ to 3 amperes per sq. ft. are used with a bath temperature of 70 to 110° F. The color of the deposit is dependent upon thickness because the color is due, fundamentally, to light interference effects. If composition, temperature and current density are held constant, the color would then merely be a function of plating time. The oxide is very resistant to high temperatures, but unfortunately, oxidation of the base metal may occur if the Electrocolor work is exposed to excessively high temperatures.

Baking lacquers requiring temperatures from 200 to 300° F. can be used.

The author then discussed the remarkable new development of "Patternplate." This process consists of depositing a cuprous oxide film in the "Electrocolor" solution and then by a change in current density, a reduction of the cuprous oxide to copper is made. Various type crystals are formed from this reduction, the crystal size depending upon such factors as thickness of plate and conditions of reduction. Close examination of the pattern form shows radial lines or concentric rings in number of the order of a diffraction grating.

Beautiful effects can be produced upon the crystal patterns by subsequently electroplating with such metals as silver and chromium or by depositing Electrocolor films. Beautiful examples of trays, bowls, and demijohns were shown.

Nickel and Copper Deposition in the Printing Industry

By James E. Dowd

Electrotype Div., The Conde Nast Engravers, Inc., Greenwich, Conn.

The author discussed electroplating in the printing industry and described in particular, electrotypes and rotogravure cylinder making. The first operation in the manufacture of electrotypes is the duplication of the plate by the use of wax or lead. Hydraulic presses are used to press the wax against the mold, which has been previously coated with graphite to make it conductive. It was pointed out that the reproduction of a 120 screen plate involved the reproduction of 14,400 dots per sq. in. An aqueous solution in graphite is used. Afterwards the graphite coated wax surface is treated with a copper sulfate solution and iron powder, and then the surface is plated in an acid copper bath for from 1 to 2½ hours. When lead is used in place of wax, the graphite is eliminated. Finer reproduction is obtained by the use of lead, but higher pressures are necessary. After the pressure impression is made, the lead surface is treated with a release solution of sodium dichromate and following this, it is plated in a nickel plating solution. Every effort is made to make the deposit tough and not brittle. Anodes of high purity are necessary. After the nickel plating, the deposited nickel film is separated from the lead and the nickel is then backed with a lead-antimony alloy to render stiffness. In rotogravure printing, large cylinders from 5 to 15 inches in diameter are first copper plated. The design is applied and following this, the etching operation. The surface is then given a chromium deposit to increase the wear resistance of the surface.

Polishing Steel Specimens Prior to Plating for Exposure Tests

By Gerald A. Lux

Research Associate of American Electroplaters' Society at the National Bureau of Standards

This is Mr. Lux' first report as Research Associate of the American Electroplaters' Society. It describes methods of polishing and polishing results on specimens in preparation for further corrosion tests. Methods of examining the roughness of surfaces are described. These include:

1. Microscopic examination of cross sections.
2. The brush surface analyzer, in which a pointed sapphire tip is drawn across the surface and its vertical motion is reproduced by means of piezoelectric crystals.
3. The Profilometer, in which vertical movement while transversely scratched, is magnified by a magnetic field.
4. Reflectivity measurements.

It was found that the last named method is not particularly suited for numerical evaluation of the condition of the surface. Automatic polishing equipment was used in preparing the specimens. It was found that the amount of the metal removed in a single pass is relatively small corresponding to 0.0001-0.0005" depending upon grain size and wheel pressure. The amount of metal removed per pass increases with the wheel pressure and a minimum pressure of 35 lb. was required for the particular set-up. Less pressure was found to be necessary after the polishing wheel was used. It was found that the polishing pressure has no significant effect on the scratch depth.

The application of oil to polishing wheel heads of a given grain size materially reduces both the amount of metal removed and the Profilometer readings.

Chemical and Electrochemical Methods for the Purification of Plating Solutions

By O. A. Stocker

Electrochemist, The Rufert Chemical Co. Div., The Seymour Mfg. Co., Seymour, Conn.

Methods for removal of both inorganic and organic impurities from plating solutions by electrochemical and chemical methods are discussed. These methods include: (1) precipitation and removal by filtration as a solid; (2) change in constitution by chemical treatment so that the impurity may be removed by other means such as carbon filtration or the effect of the impurity nullified, and (3) co-deposition of the impurity with the metal of which the bath is made up.

The Hull cell and bent cathode tests are recommended for the detection of impurities. Actual methods are outlined for the purification of nickel, copper cyanide, acid copper, brass, cadmium, cyanide zinc, acid zinc and silver solutions.

The Use of Rubber in the Plating Room

By C. P. McHugh

Chemical Engineer,
Manhattan Rubber Mfg. Div.,
Raybestos-Manhattan, Inc.,
Passaic, N. J.

The author first discussed various types of rubber, such as soft and hard rubber and then the various types of rubber applied to plating tanks. These include:

1. Semi-hard rubber
2. Soft rubber
3. Combination of soft and semi-hard or alternate layers of soft-hard-soft rubber
4. Sprayed latex coatings

The practice of putting a layer of soft rubber underneath a layer of hard rubber to resist mechanical and thermal shock was not approved. This practice, the author stated, tended to cause rupture of large patches of the rubber whereas with hard rubber alone, the stress is exerted over smaller areas. The combination soft-hard-soft layers of rubber has good resistance to thermal and mechanical shock, but the outer layer of soft rubber is less resistant to chemical attack than is hard rubber.

The methods of applying rubber to tanks were then discussed. Careful testing by means of a high tension was stressed to make certain that pin holes or foreign materials were not present in the coating. Resistance of rubber to various chemicals was then outlined and the advantages of rubber were enumerated. Cases where the rubber contaminated plating solutions were reported to be rare. However, wetting agents were stated in some cases to have a softening action on the rubber.

Postulations as to how plating can occur upon rubber linings were then made. This can be done from undissolved salts remaining upon the rubber, from metal sulfide formation, or from excessive treeing.

Measurement, Significance and Control of pH in Cyanide Plating Baths

By Dr. Allen G. Gray

Electroplating Division,
E. I. du Pont de Nemours & Co.,
Cleveland, Ohio

The study of pH in cyanide plating baths including the various types of cadmium, copper, zinc and brass solutions has shown the importance of controlling this factor since it has an important effect on the operating characteristics of the bath and the quality of deposit produced.

The electrometric method for pH control of cyanide plating baths using the high alkaline Beckman "type E" glass electrode was found satisfactory and can be recommended for pH measurements and caustic titrations in all cyanide plating baths. The effect of pH and caustic content of a cyanide plating bath on the current density range characteristics was studied by means of the Hull cell, where it is possible to record on a single flat cathode plate the character of deposit produced at all current densities within the entire operating range.

The pH range for successful operation of a cadmium plating bath is fairly wide, however, increase in alkalinity beyond a certain definite value resulted in a dull burnt cathode plate over the larger portion of the operating range. The du Pont "Cadalyte" bath gave optimum results when operated at a pH of 13.3 representing a normal content of 3 oz./gal. of caustic soda. Additional caustic up to 3 oz./gal. over this value showed no noticeable effect, and further additions of caustic produced a dull deposit with a narrow bright plating range in the low current density region. Ordinary cyanide cadmium baths appeared to give best plating results at a pH of 11.0-12.0

The pH of cyanide copper plating baths influences the structure and appearance of the deposit produced, anode behavior, cathode efficiencies, and rate of cyanide decomposition in the solution. Operation of the Rochelle copper bath in the pH region 9.5-11.0 produced a marked tendency toward streaked deposits in the lower current density range which disappeared with additions of caustic and in the pH region 12.4-13.3 smooth matte deposits were produced within the entire current density operating range. The ordinary cyanide copper plating bath gave optimum plating characteristics in the pH region 11.4-13.3. The trend toward the high pH cyanide copper plating bath is best exemplified by the successful development of the du Pont "High Speed" Copper bath which when operated at a pH of 13.3 (total caustic 4 oz./gal.) plus additions of 1-4 oz./gal. of caustic soda, produced bright smooth deposits over the entire current density operating range with anode and cathode efficiencies of 100 per cent.

Operation of a cyanide zinc bath with too high a pH value from caustic additions invariably resulted in a general dullness of deposit while the use of low pH values gave poor anode corrosion; thus the specific range for operation of cyanide zinc plating systems is represented by the fairly well defined pH region intermediate between these two limiting conditions which in general is a pH value of 12.2-12.7. The best region for operation of the ordinary cyanide zinc solution is a pH of 13.5 plus additional caustic not exceeding 5 oz./gal.; the du Pont bright zinc bath should be operated at a minimum pH of 13.0 and a maximum pH not exceeding 13.7, these pH values representing total caustic content approximating 10-15 oz./gal. A brilliant zinc deposit over the entire plating range was obtained from the du Pont "Zin-O-Lyte" solution at a pH of 13.5 (10.4 oz./gal. total caustic), and the solution would tolerate an additional 3 oz./gal. caustic soda before there was any evidence of dulling in the deposit.

The successful operation of a brass plating bath is dependent on the control of the pH of the solution since this factor to a large extent determines the ratio in which the copper and zinc co-deposit. Lowering the pH increases the percentage of copper in the deposit while increasing the pH stimulates the deposition of zinc. Coats' rubber adhesion brass gave the optimum current density operating range at a pH of 10.6. The du Pont "High Speed" Brass process represents a new development in an efficient rapid brass plating bath giving smooth bright deposits over a wide operating range at a pH of 11.9-12.1 (about 12.5 using acyl blue indicator).

The realization of the importance of pH control of cyanide plating baths together with the development of a suitable method for making such measurements represent another definite forward step in the direction of placing electroplating on a fundamental scientific basis.

Copper Oxide Rectifiers for the Electroplating Industry

By I. Albert Lee

General Electric Co.,
Bridgeport, Conn.

The author presented a thorough discussion of copper oxide rectifiers. He described the specific valve action of electrons as observed in copper-copper oxide systems. The care required in manufacture of copper oxide films was outlined. Specific constructional details of the rectifying unit including voltage control were then outlined. Comparisons were made of operating efficiencies between motor generator sets and rectifiers. The rectifier has a higher efficiency in the lower range of load (50% or lower), whereas the motor generator set is slightly more efficient at higher loads.

Throwing Power of Plating Solutions

By George B. Hogaboom

Hanson-Van Winkle-Munning Co.,
Matawan, N. J.

The author first showed that there was no correlation between specific resistivities of plating solutions and throwing power. Some resistivities reported for various solutions were as follows:

Chromium plating solution	1.44	ohms/cm³
Acid copper	5.98	"
Stannate tin	8.8	"
Watts type nickel	11.37	"

The surprising observation was made that an addition of hydrogen peroxide increased specific resistance of the watts nickel solution from 11.37 to 16.16 ohms/cm³. Mr. Hogaboom pointed out that the specific conductivity of metals should also be a factor in throwing power. Different types of diffusion on various surfaces of irregular cathodes make standard throwing power determinations of doubtful value and thus throwing power is greatly dependent upon the specific shape of the object being plated.

Die Cast Finishing

By Martin F. Maher, Jr.

Etched Products Corp.,
Long Island City, N. Y.

The speaker presented a report on an interesting study of the effects of variations in the pH of copper plating solutions on blistering of copper plated zinc base die castings. After heating, the author found for example, that excessive blistering occurs in the high pH region and drops successively until a pH of 9.4 is reached at which pH a minimum of blistering occurs.

The Corronizing Process of Metal Coating†

BY RICHARD RIMBACH

Standard Steel Spring Co.,
Coraopolis, Pa.

ALMOST every discussion of a new corrosion resistant coating or corrosion resistant alloy starts with a theory of corrosion which will place the particular product in a most favorable light. Then very briefly at the end, the real data obtained on the product, are given.

After several years of research on corrosion protective coatings, in connection with the company's automobile bumper production, the Standard Steel Spring Company has developed metallic coatings with extraordinary corrosion resistant properties. The results obtained were so remarkable and the need for reducing consumption of strategic materials, required for National Defense, was so great that Mr. Enos, the President of the Standard Steel Spring Company, has permitted the presentation of this paper rather than to withhold this information until patents were granted.

The Corronizing Process

Corronizing is a coating consisting of a number of very thin layers of metals and alloys having unusual corrosion resisting properties.

The process, for the present, comprises applying thin composite coatings of nickel and zinc, or nickel and tin by electroplating. Either ferrous or non-ferrous metals or alloys can be Corronized. The base metal is first thoroughly cleaned in an alkaline cleaner to remove grease and dirt, and preferably pickled. The better the condition of the metal surface before plating, the better will be the appearance of the coating.

A possible sequence is set forth in Table 1.

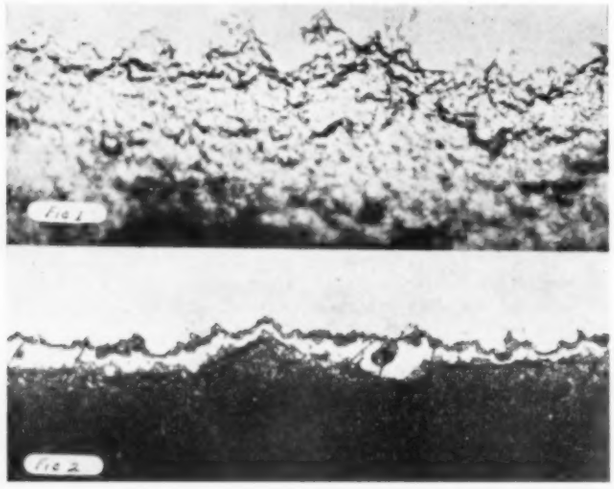


Fig. 1 (Top). Photomicrograph of nickel zinc interface. 250x.
Fig. 2 (Bottom). Layers formed by heat treatment at 675° F. for 6 hours.

TABLE I

SEQUENCE OF OPERATIONS IN CORRONIZING

1. Cathodic cleaning		
Cleaner:	Soda ash	3-5 oz./gal.
	Sodium hydroxide	0.4-0.8 "
	pH	12.6-13.2
	Current density	20-60 amp./sq. ft.
	Operating temperature	180° F.
2. Rinsing		
3. Pickling (used only when samples are rusted or scaly)		
Pickle:	Sulfuric acid (55-57° Be)	3% by vol.
	Operating temperature	160° F.
4. Rinsing		
5. Anodic pickling		
Pickle:	Sulfuric acid (55-57° Be)	
	Current density	20-200 amp./sq. ft.
	Operating temperature	160-180° F.
6. Rinsing		
7. Nickel plating		
Solution:	Nickel sulfate	28-35 oz./gal.
	Nickel chloride	4-6 " "
	Boric acid	4-5 " "
	pH	2.0-5.0
	Current density (up to 400 amp./sq. ft.)	
	Operating temperature	120-125° F.
8. Rinsing		
9. Zinc plating		
Solution:	Zinc sulfate	35 oz./gal.
	Ammonium chloride	2 " "
	Aluminum sulfate	2 " "
	pH	3.5-4.0
	Current density (up to 300 amp./sq. ft.)	
	Operating temperature (room)	
10. Rinsing		
11. Drying		
12. Heat treating		
	Temperature	500-750° F.
	Time (up to 6 hours)	

After the nickel and zinc (or nickel and tin) coatings have been plated, the coatings are heated for varying times and temperatures, depending on the thickness or gage of the base stock and the conditions which the coatings must meet. For this discussion I will confine my remarks to the nickel-zinc Corronized coatings.

Fig. 1 shows the nickel-zinc interface of the electroplated coatings before the heat treatment. The magnification in the original micrograph is 250x and the sample was etched in a mixture of chromic acid and sodium sulphate.

Fig. 2 shows the various layers formed by a heat treatment at 675° F. for 6 hours. Magnification and etching solution are the same. A nickel layer remains which is shown at the top. The dove-gray layer is the beta phase

† A paper read by Mr. Rimbach, in Pittsburgh, at the May 1st, 1941, meeting of the Galvanizers Committee.

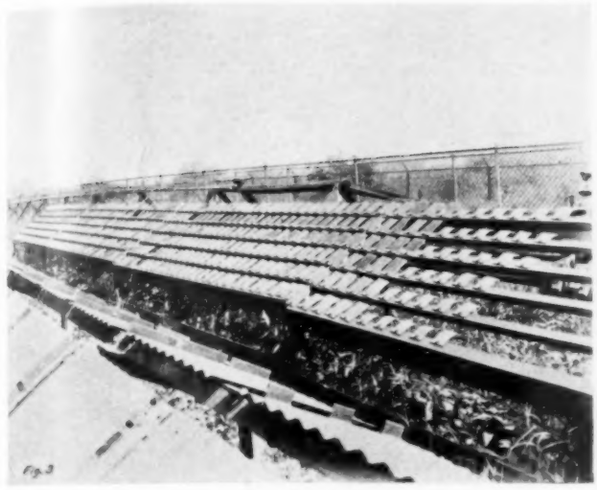


Fig. 3. A.S.T.M. exposure racks at Brunot's island.

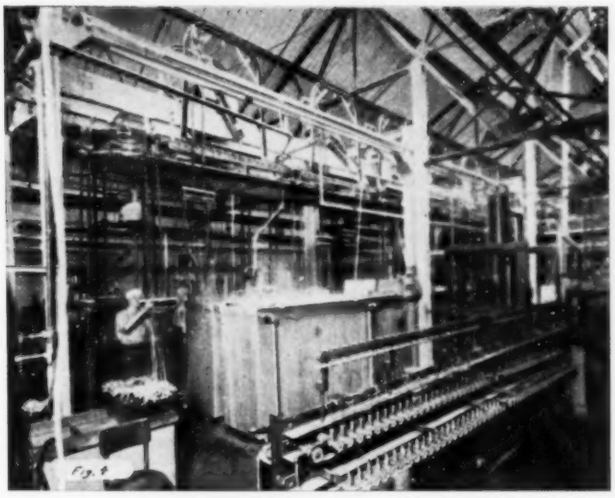


Fig. 4. View of Corronizing dept. of Robertshaw Thermostat Co.

(47 to 52% nickel), the dark layer the gamma prime phase, the gray layer the gamma phase (15% nickel) and in this sample some free zinc remains.

X-ray methods of identifying the phases in the Corronized coatings were inapplicable. For their identification, the solution potentials of fused alloys of nickel and zinc of known composition were compared with the potentials of the alloys in the coatings. For this identification, a method involving the anodic dissolution of the coatings was applied. The method is that of anodic dissolution by a constant impressed current, the time required for the dissolution of each phase being proportional to the thickness of that phase.

Test Results

Wire, strip and sheet protected by a Corronized coating have not as yet been in service sufficiently long to give the complete history of service life; however, the condition of test samples to the present confirms the anticipated advantages.

Samples have been mounted on test racks located alongside the A.S.T.M. racks at Brunot's Island. (Fig. 3) Table 2 shows the coating thickness of these various samples and time to failure when exposed to the weather.

The chart gives a relation of corrosion resistance of coatings of nickel, zinc and Corronized to coating thickness. This chart shows the initial failure in salt spray.

Table 4 gives a comparison of various weights of galvanized coatings with Corronized on sheet and wire and initial failure in salt spray. The last column in this table gives the saving in zinc, if Corronized coatings are substituted for galvanized.

TABLE II

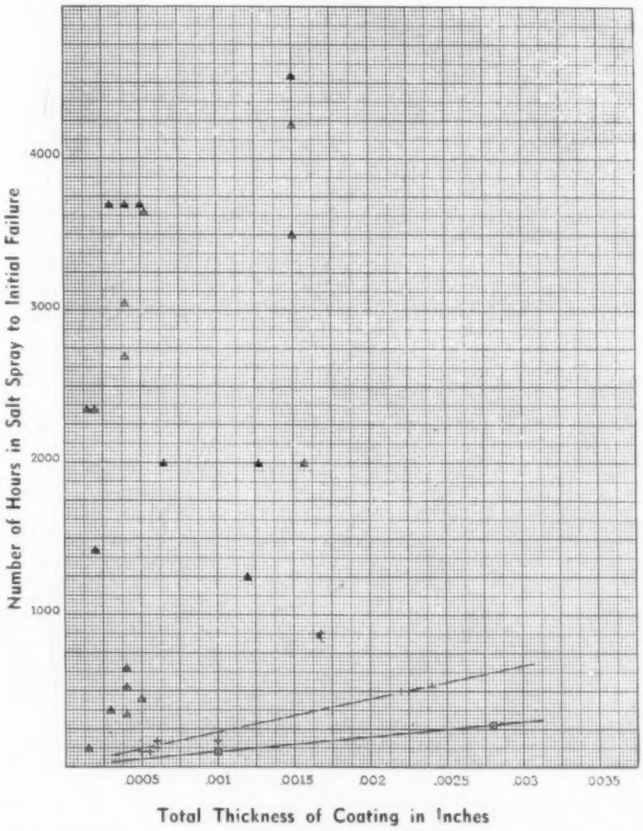
ATMOSPHERIC TEST ON ELECTROGALVANIZED & CORRONIZED

	Coating Thickness in Millionths Inch	Initial Failure in Months
Electrogalvanized	150	3
	200	4
	275	O.K. at 5 Mos.
	350	O.K. at 5 Mos.
Corronized	120	O.K. at 5 Mos.
	143	O.K. at 5 Mos.
	225	O.K. at 5 Mos.
	320	O.K. at 5 Mos.

Applications

A number of actual applications of the Corronized coatings are now in production.

Thermostats—The Robertshaw Thermostat Company is coating copper tube oven thermostats. Fig. 4 is the Robert-



Salt spray test on metallic coatings. △ Corronized coating, initial failure; ▲ corronized coating, still O.K.; + Zinc coatings, initial failure; o nickel coatings, initial failure.

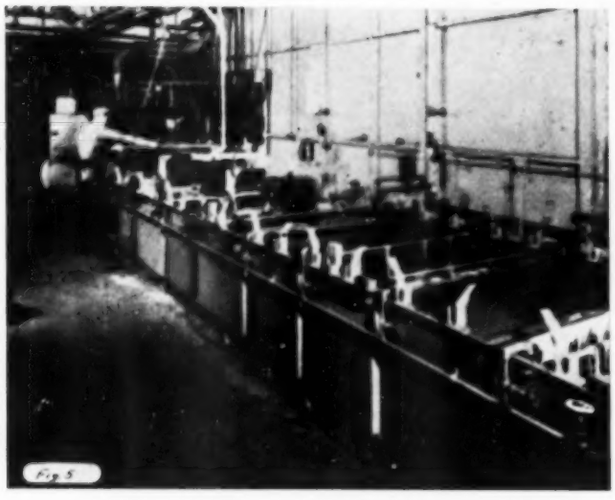


Fig. 5. View of actual corronizing tanks at Robertshaw Thermostat Co.

• ● •

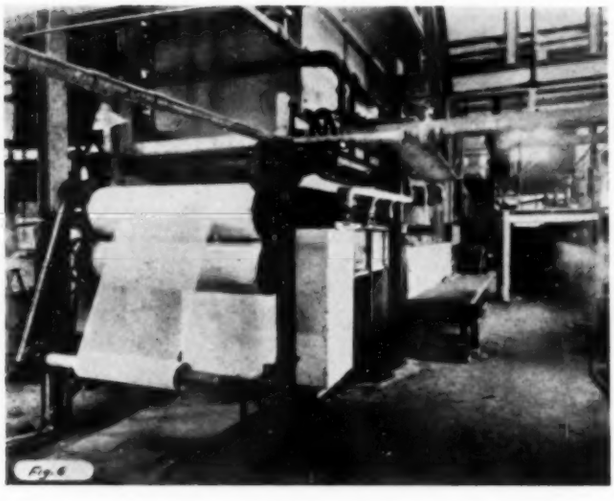


Fig. 6. Installation for producing corronized fly screen. The Hanover Wire Cloth Co., produces 4,000,000 sq. ft. of fly screen per month.

shaw Corronizing Division. This shows the thermostats mounted on a rack before passing to the cleaning operation.

Outboard Motor Parts—A Corronizing installation for coating many outboard motor parts has been made at the Evinrude Plant of the Outboard, Marine & Mfg. Company. Corronizing is replacing other metallic coatings on the products of this company. Fig. 5 shows this installation.

Fly Screen—One of the most successful applications of the Corronized coating was developed in conjunction with the Technical Laboratories of Sears, Roebuck and Co., and

TABLE III

COMPARISON OF GALVANIZING AND CORRONIZING ON NO. 22 GAGE SHEET STEEL

	Thickness Millionths of an Inch	Hours to Initial Failure in Salt Spray	Saving in Zinc (Appr.)
Galvanizing 0.7 oz./sq. ft.	600 Zinc	60	
Galvanizing 1.25 oz./sq. ft.	1100 Zinc	200	
Galvanizing 2.5 oz./sq. ft.	2200 Zinc	500	
Corronizing	25 Nickel— 75 Zinc	60	7/8
Corronizing	60 Nickel—130 Zinc	300	7/8
Corronizing	90 Nickel—120 Zinc	500	15/16

COMPARISON OF GALVANIZING AND CORRONIZING ON NO. 9 WIRE

	Thickness Millionths of an Inch	Hours to Initial Failure in Salt Spray	Saving in Zinc (Appr.)
Galvanizing 0.345 oz./sq. ft.	580 Zinc	70	
Galvanizing 0.500 oz./sq. ft.	850 Zinc	120	
Galvanizing 1.25 oz./sq. ft.	2000 Zinc	240	
Corronizing	100 Nickel—100 Zinc	140	7/8

Corronized screen is being produced by the Hanover Wire Cloth Company and is on sale in the retail stores of Sears, Roebuck and Co. At present, four million square feet of fly screen is produced per month. This installation is shown in Fig. 6.

Insecticide Sprayer Tanks—Fig. 7 shows one of the first applications of the Corronized coatings on steel sheets. Many thousands of these tanks were sold during the summer of 1940. These tanks were fabricated by soldering. This year, the fabrication cost on many thousands more has been reduced by welding.

Other Applications—Many other applications have been investigated. Pump rods have been Corronized and tested

TABLE IV

ACCELERATED CORROSION TESTS ON WELDED GALVANIZED AND CORRONIZED WIRE

			Initial Failure of Welded Wires in Salt Spray (3 wires in each set)			Initial Failure of Welded Wires in Humidity (3 wires in each set)		
Coating	Thickness in Millionths of an Inch	Initial Failure of Straight Wires in Salt Spray (4 wires in each set)	Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN Machine	Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN Machine	Welded on a Taylor-Winfield 20 KVA, Type W Machine	Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN Machine	Welded on a Taylor-Winfield 7J KVA, 220 v. Type EN Machine	Welded on a Taylor-Winfield 20 KVA, Type W Machine
Hot-dip Galvanized	560	4 in 120 hr. 2 in 120 hr.	1 in 48 hr. 2 in 120 hr.	3 in 120 hr.	2 in 72 hr. 1 in 120 hr.	2 in 96 hr. 1 in 168 hr.	2 in 96 hr. 1 in 120 hr.	3 in 96 hr.
Hot-dip Galvanized	1750	4 in 288 hr.	1 in 120 hr. 2 OK 264 hr.	1 in 72 hr. 2 in 120 hr.	1 in 72 hr. 2 in 120 hr.	3 OK 264 hr.	1 in 120 hr. 2 in 144 hr.	1 in 96 hr. 2 in 120 hr.
Electro-Galvanized	1180	3 OK 288 hr. 1 in 288 hr.	1 in 144 hr. 2 in 216 hr.	1 in 72 hr. 2 in 216 hr.	2 in 72 hr. 1 in 264 hr.	2 in 120 hr. 1 in 264 hr.	1 in 120 hr. 2 in 192 hr.	2 in 120 hr. 1 OK 264 hr.
Corronized	340	2 in 288 hr. 2 OK 288 hr.	3 OK 264 hr.	3 OK 264 hr.	1 in 264 hr. 2 OK 264 hr.	2 in 216 hr. 1 OK 264 hr.	1 in 168 hr. 2 in 192 hr.	3 in 168 hr.

Fig. 7. A tank made of corronized steel. These tanks were fabricated by soldering. This was one of the first applications of corronized steel sheet.

under all kinds of conditions. Metal stampings and formed parts have been tested and Corronizing such fabricated parts in electroplating departments without the addition of any equipment has been started.

Oil Cans—A sample of an oil can body, which was put through a can machine by the Continental Can Company, shows a light-colored streak at the seam where it was evidently abraded by the can-making machinery. Tests on such a can body were made, however, by an independent laboratory which determined the coating thicknesses as 0.000096" of nickel and 0.000259" of zinc. Salt spray tests were made which showed initial failure of 1230 hours on the seam and 1262 hours away from the seam.

Wire—Recently very extensive tests have been carried out by the Sears Laboratories, in conjunction with our Research Laboratory, to determine the possible application of Corronized wire to welded fence construction. Our laboratory received samples of three different lots of #14 gage galvanized wire, illustrated in the following micrographs, all having a magnification of 1000x and etched in 0.5%. Nital for five seconds. Fig. 8 shows a hot-dipped coating with a thickness of 560 millionths of an inch of zinc, Fig. 9 a hot-dipped coating with 1750 millionths, Fig. 10 an electrogalvanized coating of 1180 millionths. Fig. 11 shows the Corronized coating prepared in our laboratory on a single strand line. This coating has a thickness of 340 millionths.

Samples of all wires were welded by the Research Department of the Taylor-Winfield Corporation. Welded specimens, straight control specimens and bent specimens of each wire were placed in atmospheric corrosion, salt spray corrosion and humidity tests. The time has been too short for failures to have occurred in the atmosphere but the results of the salt spray and humidity are available. The laboratory reports "Corronized wire when welded and twisted will resist corrosion equally as well as the better grades of galvanized fence wire."

The results of the tests are shown in Table 4. Corronized wire samples were twisted then tested in salt spray.

Advantages of the Corronized Coating as Compared with Hot-Dipped Galvanizing

1. The coating is very uniform in thickness—there are no "drip edges."
2. The thickness of the coating can be accurately controlled.
3. Does not affect physical properties of the base stock.
4. The coating is very ductile and adheres perfectly so that it will neither peel, crack nor flake when bent around a diameter equal to the thickness of sheet or when wrapped around its own diameter in the case of wire.
5. Coating surface is smooth, compact and can be made semi-bright on wire.
6. Initial failure does not progress as fast with the Corronized coating as it does with other coatings. In case of galvanized material, the complete failure of the sample occurs shortly after the initial failure, whereas in the Corronized coating, it has been found that in many cases the coating has self-healing features after an initial failure has occurred.

(Some of the advantages mentioned above, of course, apply to electrogalvanizing as well as to Corronizing.)

Costs

Up to the present, electrogalvanized coatings comparable in thickness and corrosion life could not compete in cost

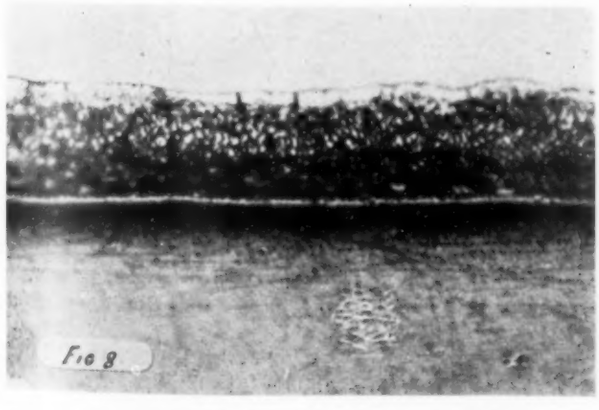


Fig. 8. Photomicrograph of a hot dipped coating with a thickness of 660 millionths of an inch of zinc.

Fig. 9. Photomicrograph of a hot dipped coating with 1750 millionths of an inch of zinc.

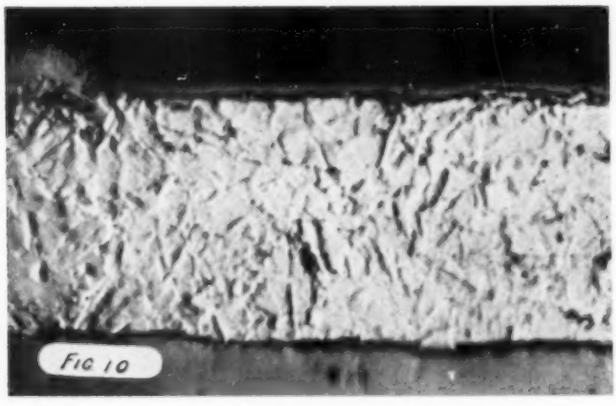


Fig. 10. An electrogalvanized coating with 1180 millionths of an inch thickness.

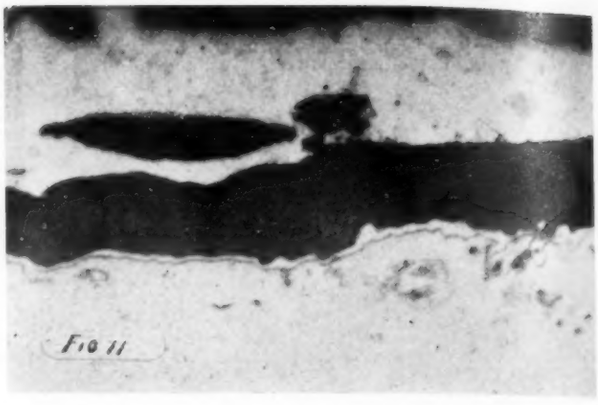


Fig. 11. Photomicrograph of a corronized coating prepared in the author's laboratory on a single strand line. The coating is 340 millionths of an inch thick.

with hot-dipped coatings. For heavier coatings, of course, electrogalvanizing does not have to compete with hot-dipped coatings since electrogalvanizing has this field to itself.

Present indications are that the cost of applying the Corronized coatings, due to the fact that thinner coatings have corrosion resistance equal to much heavier galvanized coatings, will be equal to or less than hot-dipped coatings.

The cost will obviously vary with the equipment installed, the wire or strip gage, the thickness of deposit and the power cost.

A very recent development of the Corronized coating permits the production of a bright coating. The appearance of this coating as it leaves the Corronizing line is a silvery lustrous finish. It is easily as bright as the wiped hot galvanized wire and is of a much more lasting nature. It will not darken as quickly as the latter when exposed to the atmosphere.

• • •

Aluminum Plating Process

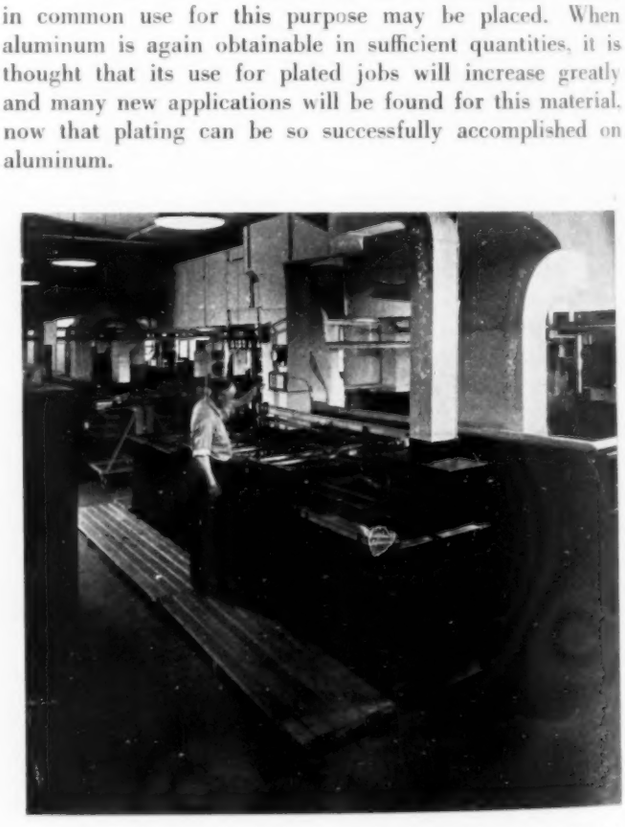
It is now claimed that aluminum may be prepared for electroplating at a cost of approximately $0.0025 a square foot. An installation for plating aluminum is said to cost about $500 for all the equipment necessary for a 15 kw plating plant.

A process of the kind mentioned is one that is known as the Krome-Alume method, which does the anodizing with alternating current, requiring only two chemicals and taking from 11 to 20 minutes to prepare. An almost uncanny adhesion is produced, even with the use of the cheaper grades of material such as 2S and 3S. Experience has shown that plated 2S sheets can be punched and formed, so that even the crimping dies do not produce a tendency to lift or peel at the point of stress.

With this process, plating has been tried successfully on aluminum die castings, as well as on wrought or extruded metal. A resistance to wear has been shown, permitting heat as high as 600° F. Salt spray tests as long as 300 hours have been withstood by 0.0002" of nickel.

A typical installation of Krome-Alume plating equipment is in use at the plant of the Eastman Kodak Co., Rochester, N. Y. In this plant it is used to plate die cast aluminum camera cases, which are put through in large quantities. A 15 kw transformer is used, with a tapped secondary so that during anodizing the current can be built up gradually to about 5 amps. per square foot. The usual water rinses and standard tanks comprise the balance of the plating equipment for this purpose.

Nickel is recommended as the best plating material next to the aluminum. Over the nickel most of the other metals in common use for this purpose may be placed. When aluminum is again obtainable in sufficient quantities, it is thought that its use for plated jobs will increase greatly and many new applications will be found for this material, now that plating can be so successfully accomplished on aluminum.



View of installation for plating upon aluminum at Eastman Kodak Co., Rochester, N. Y.

X-Ray Measurement of Silver Plating Thickness

BY ROBERT C. WOODS

Physicist, Bell Aircraft Corp.

Buffalo, N. Y.

Introduction

THICKNESS tests of electrodeposited metals are now routinely made by microscopic measurement, by various acid tests, by the chord method, by electrochemical processes, or—where ferrous materials are concerned—by magnetic means. With the exception of magnetism, however, all these methods require destruction or injury of the examined sample and the time taken for preparation of the specimen, actual test procedures, and final correlation of data is considerable.

While the results about to be described are only preliminary and may seem somewhat crude to the mathematician, they nonetheless hold some promise of future value to the plating industry in general and more especially to the silverware trade. X-ray determinations in almost any field have the advantage of being completely non-destructive and are fairly rapid when compared to the tests mentioned above. Actual feasability of the X-ray method has as yet been proven only for the measurement of plating thicknesses on the silver overlay on tableware spoon bowls. Even so, the determination appears to be accurate to within a few per cent, although it must be admitted favorable conditions prevailed.

Principles of X-ray Absorption

To obtain any clear picture of this method, the reader must pardon a brief digression into some of the theoretical concepts dealing with X-ray absorption in metals. In passing through a material layer—either metal or any other substance—an X-ray beam experiences a number of changes and transformations. Although the analogy is far from scientifically exact, let us imagine a heavy water jet issuing from a high pressure nozzle and directed squarely at a fine holed sieve. As the apparently composite stream strikes the sieve, some of it passes through untouched, part is broken up into droplets which—while they may pass through—spread out in various directions, and still another component hits the solid walls between the holes and splashes backwards. If we should substitute X-rays for the water and intercrystalline spaces for the sieve holes, a rough idea of how X-rays are "absorbed" in matter can be visualized. An X-ray beam, of course, is not really as continuous a process as the water stream seems to be, because it is composed of many units of energy which manifest themselves

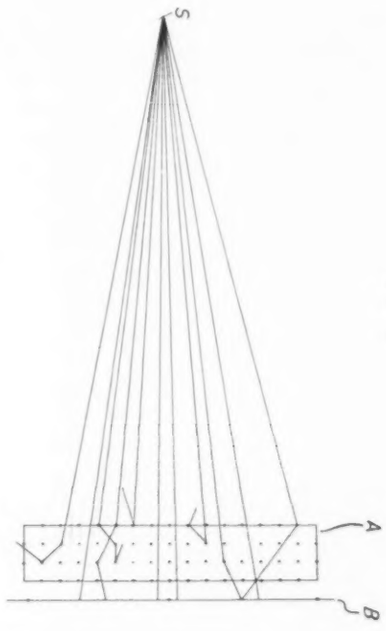


Fig. 1. X-ray absorption in metal block "A". "S" is X-ray source and "B" is photographic film.

sometimes as waves and again as corpuscular particles, or photons. So that in traversing a steel plate, for example, we refer to those X-rays which fail to go through as being absorbed, as in Fig. 1. In this illustration, X-rays are represented as straight lines, rather than waves, merely to simplify the picture.

One other phenomenon which may be a factor in the present experiment is the matter of secondary X-rays. It is well known that under X-ray bombardment, intra-atomic transformations occur which result in the emission, from within the atom, of an X-ray photon whose wave length is determined within certain limits by the type of atom acting as the radiator. Thus, given sufficient energy in the exciting radiation, nickel atoms radiate energy of one wave length, copper of another, silver of another, and so on. Some of these characteristic rays, as from the element lead, are quite penetrating and must be eliminated as much as possible by suitable filters, so as not to confuse the picture.

Reverting briefly to the nozzle and sieve simile, it is evident that the amount of water actually passing through the sieve holes—and also the directions in which the droplets may be scattered—are dependent both on the size of the holes and the force behind the water stream. If we extend

Fig. 2. Radiograph of a teaspoon bowl with a heavy silver overlay.

Fig. 3. Radiograph of silver plated teaspoon bowl without silver overlay.

Fig. 4. Silver step tablet. "A" is base metal strip of nickel silver, "B" is strike deposit, and "C" silver deposits of increasing thickness.

this analogy to radiation and matter again, we must logically assume that X-ray penetration, or absorption, is a question of primary radiation energy as well as spacing and size of the material particles between which the rays slip. And, as a matter of fact, that is exactly the situation, for X-ray absorption can be accurately calculated from a knowledge of radiation wave length and the mass absorption coefficient of the material traversed. This latter factor is, in turn, calculated by a formula involving densities, atomic weights, and wave lengths. What the exact relation is, need not concern us at the moment, but we must not make the mistake of thinking that a 2" steel block will absorb just twice as many X-rays as a 1" block, for it is not a linear relation at all.

An example of this, and one right to the point, is a comparison between the densities of nickel, 8.90, and of silver, 10.50. If X-ray absorption were proportional to material density alone, we should expect about 18% more absorption in silver than in nickel. Or, again, if it were proportional to their atomic weights, silver would absorb 100 per cent more than nickel. Happily, however, at the X-ray wave lengths purposely chosen for this experiment, silver absorbs X-rays three times more strongly than an equivalent thickness of nickel. In short, it is often possible to select X-ray wave lengths so that any disparity in absorption between two metals under examination is accentuated many times.

BASE
STRIKE DEPOSIT .00003"
.000087"
.000153"
.000214"
.000282"
.000416"
.000452"
.000610"
.000734"
.00105"

Fig. 5. Actual silver thicknesses as determined by the microscope.

Determining Silver on Teaspoon

Probably a more practical demonstration of absorption phenomena can be illustrated as in Fig. 2. This is an ordinary radiograph of a teaspoon bowl with an exceptionally heavy silver overlay on the base. Indeed, the method of adding the extra silver has been such that close examination of the original film shows clearly a sharp demarcation line straight around the whole overlay with little or no blending into the base silver deposit. In Fig. 3, the radiograph of a regular spoon bowl does not demonstrate this difference, although readings taken on the film with optical instruments will show that an additional silver deposit does exist.

To demonstrate the scope and limits of X-rays in this direction, it was, of course, first necessary to establish the absolute sensitivity of the method. Through the cooperation and kindness of Dr. B. Egeberg of the International Silver Company, a sheet of standard nickel-silver base material was plated in steps of increasing silver thicknesses, as illustrated by the greatly exaggerated view in Fig. 4. In radiographic parlance this is known as an absorption step tablet and it was made by lowering the base plate into a plating bath one half inch at a time at predetermined intervals. Unfortunately, silver thicknesses do not increase arithmetically but this is of little importance since accurate measurements were made by Dr. Egeberg using the microscopic method. Actual silver thicknesses are given in Fig. 5.

Experimental procedures were as follows: The tablet was placed on a special fine grain type of X-ray film and lead

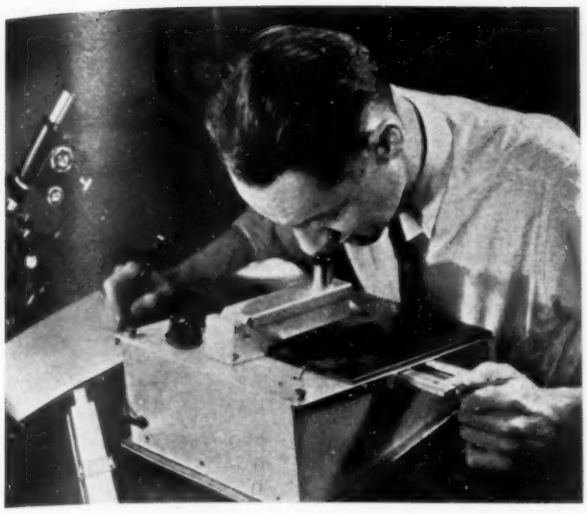


Fig. 6. Densitometer for reading density of X-ray negatives.

sheets positioned to eliminate all chance of recording any rays but those which had passed directly through the specimen. Between the step tablet and the film a filter was used to obviate the possibility of characteristic silver radiation exposing the film and confusing results.

While it was possible to observe by eye on the finished film a gradual change in blackening from the most thinly plated end to the thickest, individual steps could not be distinguished as such. For more exact measurements, the radiograph was examined by means of a transmission densitometer modified for the viewing of X-ray film. This optical instrument compares the blackening of a photographic film against standard blackness densities recorded on an optical wedge incorporated in the device. When a film is properly placed, as in Fig. 6, and a minute area examined through the eyepiece, two concentric fields appear which can be matched in intensity by rotation of a compensating wedge. Readings obtained are simply a convenient way of expressing the light-stopping power of a photographic image and are logarithmic values equal to the

$$\text{logarithm of } \left(\frac{1}{\text{light transmission}}\right).$$

About sixty exposures were made using different techniques, filters and types of

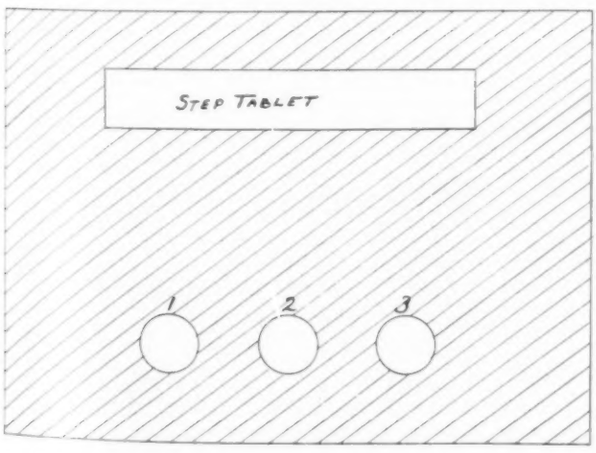


Fig. 7. Lead sheet with areas removed for X-ray exposure of silver step tablet and three spoon bowls.

TABLE I

Total Ag Thickness In.	Film Density Reading
0.	1.10
0.00003	1.78
0.000117	1.05
0.000183	1.028
0.000244	1.00
0.000312	0.983
0.000446	0.964
0.000482	0.924
0.000640	0.890
0.000764	0.850
0.00108	0.780

film. When an apparently suitable technique was finally set up, ten checks were run and found to agree reasonably well, at least within a small fraction of a per cent. Listed in Table I is a set of sample results. It will be noticed that variations of film density figures do not coincide very well with variations in actual plating thicknesses, but the writer feels this may be due to slight differences in base plate dimensions and considerable confidence is derived from the fact that the general trend is always in the right direction, even when variations are exceedingly small.

Referring again to Table I, we find definite indications of absorption difference between every step, as from #5 to #6 where there is a real change of only 0.000036" of silver. If step #6 is taken as a standard, then #5 represents a deficiency of 7% silver plate. In arriving at this result, it must be remembered that the strike deposit of 0.00003" underneath the tablet has to be included in the total silver thickness since the X-rays pass through both top and bottom silver deposits. Were the silver deposited on one side only, the sensitivity would naturally be much higher as far as this particular application is concerned.

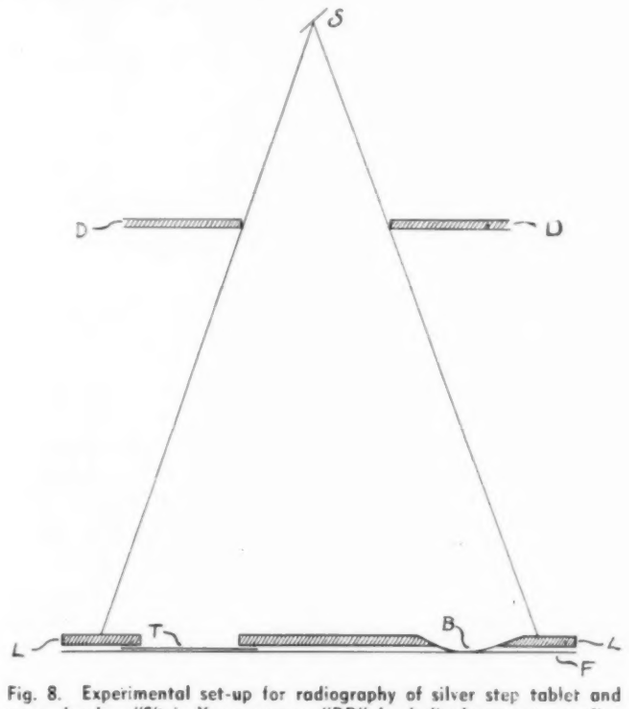


Fig. 8. Experimental set-up for radiography of silver step tablet and spoon bowls. "S" is X-ray source, "DD" lead diaphragms to confine X-ray beam, "L" is lead plate, "T" is step tablet, "B" is spoon bowl, and "F" is photographic film.

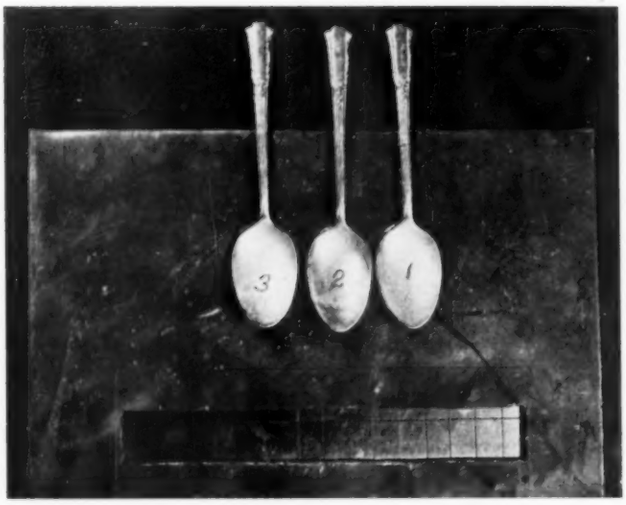


Fig. 9. Photo of lead diaphragm with step tablet and spoons ready for exposure.

Because no difficulty whatever has ever been experienced in detecting the difference between the smallest steps, #5 and #6, it appears safe to assume the X-ray method, as here used, is accurate to within at least 7%. Even when small variations in the base plate exist, this figure would probably hold good, because reasonable differences in the nickel-silver content do not play such a vital role in the total X-ray absorption.

Application of these results in practice may be affected in a number of ways. Due to such variables as film speeds, exposure factors, and development techniques from one radiograph to another, it will always be necessary to expose some sort of standard absorption plate along with the article on which the metal deposit is to be measured. Moreover, a step tablet similar to the one described here makes a good standard, because densitometer readings will not only indicate whether the examined object is properly plated, but will also permit reasonably accurate measurements as to the magnitude of any variations. This is done by comparing the photographic density of the plated object image with the corresponding density of step tablet radiograph. Higher accuracy can be attained by precise milling of the base plate before electroplating, so that the surfaces are parallel.

Figure 7 shows a 1/8" lead plate with a rectangular opening slightly smaller than the step tablet and with three holes drilled and reamed so as to allow spoon bowls sitting therein barely to contact a film holder on which the whole assembly rests. The exposure set up is illustrated in Fig. 8. Fig. 9 is a photo of the lead diaphragm as used, with spoons and step tablet in place.

In the first instance, three spoons with supposedly the same amount of silver deposit were radiographed in the lead jig and densitometer readings taken in the exact centers of areas 1, 2, and 3. All readings corresponded fairly well and naturally all three could be compared to a definite step on the tablet image. However, when another set of three spoons was substituted, then relation to the tablet changed and thicknesses could be measured by comparison with corresponding step densities.

Unfortunately, facilities are not available in this laboratory for exact measurement of silver thicknesses by other methods, nor is it convenient to remove predetermined amounts of metal in the range of interest to the silverware industry. Nevertheless, in one experiment three spoon bowls were first radiographed as described and the film densities recorded. Then one of the spoon bowl bottoms was lightly touched to a fine paper polishing wheel so that it was just apparent the surface had been abraded. Micrometer measurements did not disclose any difference in thickness before and after the process. While this is admittedly a primitive technique, the change was readily detected and roughly corresponded to a removal of 0.0009" of silver.

As with the step tablet radiographs, it is impossible by the X-ray transmission method to tell whether an observed variation is located in the upper or lower plated layer. For example, when a silver deficiency is found to exist on a spoon bowl, it may be either inside the bowl or on the bottom, since the X-rays have traversed the bowl from top to bottom and have recorded only variations in the total density.

Other Uses of X-ray Method

At the moment, the X-ray method discussed here has been carried out altogether on spoon bowls, but no good reason exists why the same principle cannot be extended to include examination of many other plated articles. Nor need this process be confined to silver plating alone, for there are numerous other metals which display a similar wide variation in X-ray absorption when compared to the bases on which they are deposited. For example, as coatings or deposits we might have such elements as gold, lead, mercury, tin, platinum, tungsten, or cadmium. If any of these were plated on copper, iron, nickel, steel, aluminum, magnesium, or zinc, then X-rays should be applicable for thickness measurements exactly as described above.

While the writer is under no delusions as to the crudeness of the present method and technique, there is certainly some hope to be gained from the fact that such an unscientific experiment yielded results anywhere near as good as those obtained. Further refinement of procedures and materials should extend this X-ray method from a laboratory to an industrial instrument.

The author wishes to acknowledge the valuable technical assistance of R. Lund and R. Priess of these laboratories in the preparation of this material.

Omission From

INDUSTRIAL CHROMIUM PLATING

By A. Mankowich

Page 300, June 1941 Issue
of Metal Finishing

The following literature references were unfortunately omitted from the above article.

1. R. H. Cherry, Trans. Electrochem. Soc. **57**, 79 (1930)

2. A. Willink, Trans. Electrochem. Soc. **61**, 317 (1932)

Effects of Impurities In Plating Solutions†

BY DR. WALTER R. MEYER

Editor, Metal Finishing
New York

THE contamination of plating solutions can take place in so many ways that, obviously, it would be impossible to enumerate most of the ways in which contamination could occur. However, the following methods of contamination probably represent how over 80% of the cases of contamination do occur.

Contaminating materials or impurities in plating solutions can be classed in two groups, *organic impurities* and *inorganic impurities*. Impurities in these two groups usually enter plating solutions by different methods, although both types may be present by intentional or unintentional adding of the wrong substance to the plating solution. Labels may become lost or mixed on chemical containers resulting in the addition of the wrong chemical, and there have been cases where workmen have sabotaged solutions for various reasons and unfortunately plating solutions are particularly susceptible to sabotage. Neglecting intentional or accidental addition of impurities, some of the ways in which impurities may enter plating solutions are as follows.

Inorganic Impurities

Because of the high degree of purity of present-day chemicals for making plating solutions, impurities in plating solution chemicals are not a great source of trouble. Recent analyses of commercial copper cyanide showed, for example, lead contents ranging from 0.001% to 0.08%, tin contents from 0.001% to 0.03%, iron contents from 0.01% to 0.1%, and cadmium contents from 0.001% to 0.015%. The chief difficulty from the metallic impurities present in plating salts is from their propensity to cause dull plates or to prevent proper bright dipping.

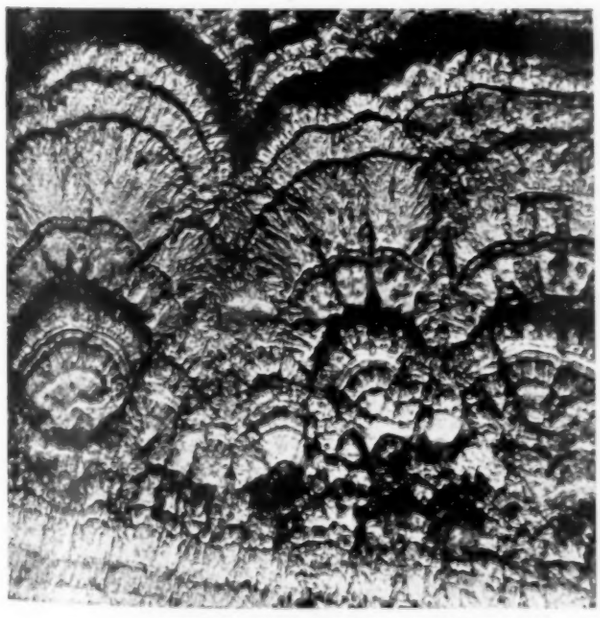


Fig. 1. Photomicrograph of heavy brass deposit showing radial growth due to presence of suspended matter in the solution. Mag. 200x.

Water may be a troublesome source of impurities and the chief difficulties from water have been discussed by Hogaboom[1] and Diggin[2]. The impurities in water may include iron, calcium, magnesium, carbonate, carbon dioxide, sulfates, chlorides and suspended matter such as clay, and organic matter. Water impurities may cause staining of the plate after drying from the residue of salts contained in the water. The chlorides may accelerate attack on steel tanks and cause anode polarization. Calcium may precipitate insoluble soap films which are very difficult to rinse off and which may cause peeling of the work or pitting.

Anodes were formerly a source of metallic impurities but high purity metal available today (if you have priority numbers) has almost eliminated anodes as a source of impurities. The major difficulty with high purity anodes is the possibility of loose solid particules being released which may cause dirt pitting or nodular growth. With the increased necessity for using scrap metals for anodes, the danger from impurities is increased and their use may require continuous use of low current density plating for the removal of foreign metals.

A frequent source of contamination is drippings from bus-bars, ventilators and conveyors, particularly in cyanide solutions. The obvious remedy is to keep such source of contamination protected with rubber or protective corrosion resistant paint.

Parts falling to the bottom of plating tanks, or recesses of work being plated, are obvious sources of contamination. Magnets, special scoops and nets are available to obviate trouble from the first-mentioned source.

Drag-in from improper rinsing of work being plated and from work containing recesses difficult to rinse, is a regular source of contamination. Combination immersion rinsing and spray rinsing is most efficacious.

A common source of contamination, particularly of chromic acid contamination, is plating racks particularly

†This paper was presented at the Annual Convention of The American Electroplaters' Society held June 9-12 at Boston.

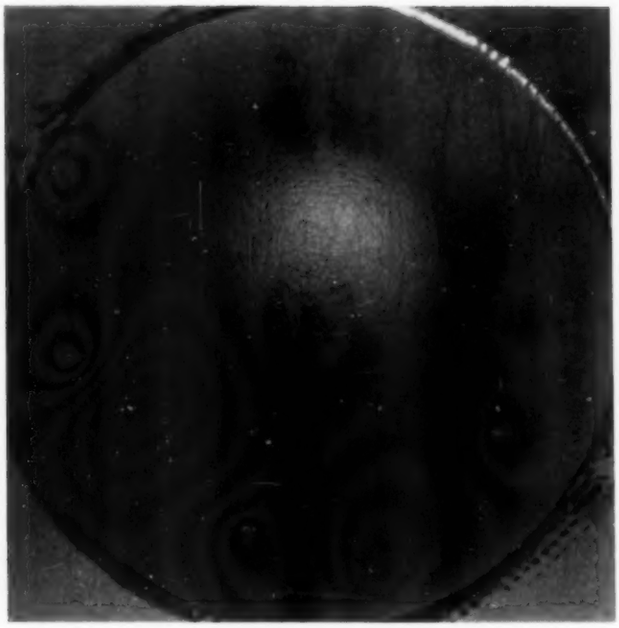


Fig. 2. Olsen draw cup of a nickel deposit that was ductile. Notice the absence of cracking.

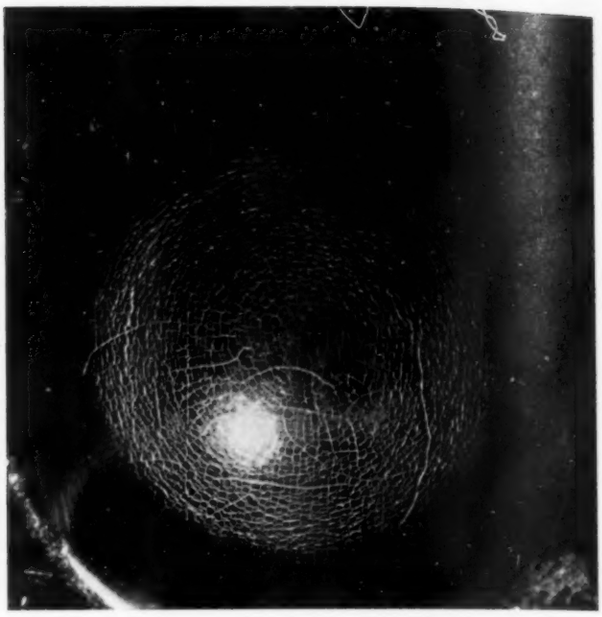


Fig. 3. Olsen draw cup of a brittle nickel deposit from a nickel solution containing an extract from unwashed filter bags.

(Courtesy Hanson-Van Winkle-Munning Co., Matawan, N. J.

those in which the rack coating tends to separate from the rack.

Organic Impurities

Organic impurities may result from the decomposition of organic addition agents, such as wetting agents added to prevent pitting. They may come from sizing in anode bags or from rubber or other organic linings of plating tanks. A severe case of contamination resulted from putting a nickel solution in a tank that had been freshly coated with a varnish and all the solvents had not evaporated from the coating.

Contamination has come from wood used as spacers in bright nickel, from wooden stirring paddles, from sawdust used in drying. Organic matter may enter plating solutions packed in crevices and displaced in the plating solution particularly when it is a low surface tension solution. Oil and grease from conveyors are frequent causes of contamination. One case of contamination resulted from using a rubber bucket for holding concentrated sulfuric acid. The acid probably sulfonated some of the unsaturated compounds present and made them soluble, or it may have decomposed enough rubber to free sufficient accelerator or anti-oxidant to cause the trouble.

DETECTION OF IMPURITIES

The detection and identification of impurities may be baffling and frequently impossible, particularly of organic impurities. The Hull cell may be used to detect impurities. Metallic impurities may show up more prominently in the lower current density range and organic impurities in the higher current density range. Metallic impurities may show as a brittleness in the coating or cause the coating to be dull, grey or black. The effects of organic impurities may be numerous and some effects may be brittleness, streaking, pitting and treeing. If organic impurities are suspected, the sample should be given an activated carbon treatment or a more drastic potassium permanganate purification or both. If the panel from the Hull cell is satisfactory after purification treatment, then it may be safely assumed that organic impurities are at fault. The bent cathode test may be used satisfactorily in place of the Hull cell.

If metallic impurities are suspected, they may be detected by spectrographic analysis, chemical analysis or by subjecting a sample of the plating solution to low current density electrolysis and running a new test in the Hull cell or with a bent cathode.

Suspended matter may be responsible for dullness, pitting or roughness and panels should be run both before and after simple filtration.

Before seeking impurities in plating solutions, it obviously would be a point of wisdom to analyze the solution to make certain that it is of the correct composition.

In detecting brittleness in plated coatings, a cup test, such as the Erichsen cup test, in which a steel ball is pressed into firmly held sheet to produce a cup of any desired depth, is valuable. Figure 1 shows tests on ductile and brittle nickel deposits.

EFFECTS OF IMPURITIES IN SPECIFIC SOLUTIONS

Copper (Acid Solutions)

Acid copper solutions are not very susceptible to impurities and the chief difficulty is the prevention of the formation of insoluble suspended matter which causes nodularization and roughness. Gelatin has been shown by Jacquet[3] to cause the deposit to form under greater strain and Hothersall[4] found that small amounts of gelatin (0.0013 oz./gal.)

increased the hardness of acid copper deposits from 42-52 Brinell to 128 Brinell. Deoxidizers from rubber have been reported to cause vertical ridges in acid copper deposits and glue (impure gelatin) has been stated to coarsen the structure probably due to causing nodular growth.

Copper (Cyanide Solutions)

As previously mentioned, the effects of metallic impurities are usually more pronounced at low current densities (less than 5 amp./ft.^{2}) and thus it is not possible to definitely state harmful concentrations without considering the plating conditions. Any values given, therefore, are only approximate.

The writer in collaboration with Arthur Phillips[5] made an extensive study of the effects of certain metallic impurities on the structure of cyanide copper deposits. The results are summarized as follows:

Lead in concentration as low as 0.00067 oz./gal. had a noticeable brightening effect on the deposit. Concentrations from 0.0067 and 0.013 oz./gal. made the deposits bright with a slight leady cast. The ductility was decreased by the lead. Concentrations above 0.013 oz./gal., particularly above 0.067 oz./gal., caused the deposits to be brittle, banded, and numerous loose trees formed.

Thallium, when present in concentrations above 0.067 oz./gal. caused the copper deposits to be more brittle and to stain a purplish color very rapidly.

Cadmium, in concentration of 0.0134 oz./gal. and higher, causes the deposits to be whiter in color and somewhat harder. The deposits are frequently banded in cross section.

Silver, in concentrations above 0.0067 oz./gal., causes a dullness of the deposit with tree formation. Low concentrations, from 0.0013 to 0.013 oz./gal. caused the deposits to be spotty.

Nickel, cobalt and tin, in concentration of 0.13 oz./gal., made the copper deposits duller or more velvety in texture.

Ferrocyanide in solution of the order of 1 oz./gal. has been observed to cause the deposits to be duller, streaky and harder to buff.

Mercury from broken thermometers was found to amalgamate with the copper anodes and cause poor anode corrosion.

Rochelle salt copper solutions contaminated with soap-like or greasy materials were stated[6] to produce deposits with a "grainy" type structure.

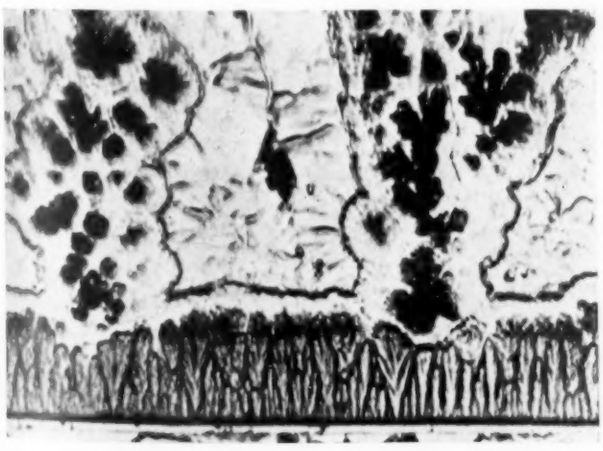


Fig. 4. Photomicrograph of a deposit of copper from a cyanide copper solution containing 0.1 g./l. of silver. Mag. 1000x.

Some work reported by M. M. Beckwith indicates that small amounts of chromic acid in copper strikes for steel can have pronounced results. As little as 0.0013 oz./gal. of chromic acid caused spotty and poor coverage. A concentration of 0.007 oz./gal. of chromic acid caused poor throwing power and part of the plate to blister. Higher concentrations caused more extensive blistering and poorer coverage. The story of chromic acid in copper plating solutions and the renovation of the plating solutions by using sodium hydrosulfite will be discussed by Dr. Beckwith later this evening. He is to be congratulated for the splendid piece of work which he has done.

Nickel Solutions

Metallic impurities are regularly found in nickel solutions.

Small amounts of cadmium are frequently added as brightener and the use of cadmium results in a marked decrease in ductility of the nickel deposits. A cadmium content of 0.13 oz./gal. caused the nickel deposit to be poorly adherent and black up to 6 amp./ft.^{2}, bright and spotty from 6 to 22 amp./ft.^{2}, and cloudy and streaky at higher current densities. Concentrations above 0.67 oz./gal. cause the deposits to be very brittle and non-adherent. A favorable range is from 0.013 to 0.067 oz./gal. of cadmium.

As little as 0.0067 oz./gal. of zinc will cause the nickel deposits at low current densities to be bright and somewhat more brittle. Higher concentrations of zinc will cause the nickel deposits to be very brittle and, for example, a concentration of 0.03 oz./gal. of zinc will cause the nickel deposits to be very brittle, particularly at the low current density range.

Cobalt from 0.13 to 0.65 oz./gal. has a slight brightening effect with only slight decrease in ductility.

The effects of as little as 0.02 oz./gal. of iron may be noticed at high current density areas by greater hardness of the deposit.

Chromic acid decreases the cathode efficiency.

Arsenic in nickel plating solutions can co-deposit with the nickel giving deposits that are brittle and which have very low tensile strength.[7]

Lead is only slightly soluble in regular nickel plating solutions, but in the presence of citrates, sufficient quantity can dissolve to co-deposit with the nickel to make the deposits fine-grained and more brittle.

Copper, up to 0.005 oz./gal., is not harmful to nickel deposits, but amounts above 0.01 oz./gal. may cause treeing or make the deposits spongy.[8]

Iron is conducive to pitting, and when co-deposited with nickel, increases the hardness and decreases the ductility of the coatings.

Organic compounds may produce one or all of the following effects: Pitting, brittleness, streaking, increase in dullness or brightness, and increase in hardness.

The ammonium radical, which is employed in many nickel plating solutions, may be an impurity in certain nickel solutions, particularly the low pH solution. Harr[9] found that the ammonium radical caused a marked increase in brittleness of nickel deposited at low pH either in the presence or absence of boric acid and at high and low temperatures.

Cadmium Solutions

Copper is the most frequent impurity in cadmium plating solutions, and in fact, most cadmium plating solutions contain some copper. Copper does not plate out appreciably unless the free cyanide content is low and thus the high free cyanide usually employed in cadmium plating, minimizes trouble from copper. Small amounts of copper have a slight brightening effect on the deposits and larger amounts, when co-deposited with the cadmium, may cause improper bright dipping.

Zinc is not as critical as cadmium and may cause the plate to deposit cloudy.

As little as 0.00013 oz./gal. of nickel in solution can be detected in the deposit and 0.0013 oz./gal. produces a marked brightening effect. The preferable range[10] is from 0.027 to 0.04 oz./gal. Cobalt is less potent than nickel and no noticeable effect occurs below 0.013 oz./gal. and effects are not significant below 0.13 oz./gal.

Silver, lead, tin, antimony and arsenic are detrimental and should not be over 0.0067 oz./gal. They tend to cause dark, coarse, spongy, loosely adherent deposits to form. Arsenic is the worst offender and as little as 0.00067 oz./gal. can be seen by the effects on the deposit. Dark, rough deposits, frequently non-adherent, are caused by the presence of arsenic. Antimony is almost as bad as arsenic, and antimony is difficult to eliminate by plating.

Occasionally, thallium may occur in the anode in sufficient concentration to cause trouble and as little as 0.001% in the anode has been reported to cause the deposits to be dull and incapable of being properly bright dipped.

Ferrocyanide regularly forms in cyanide solutions and up to ¼ oz./gal. it appears to have no effect on the appearance of cadmium plates. Above this concentration and particularly above 1.5 oz./gal., the deposits may become slightly hazy and grey.

Chromic acid in cadmium solutions tends to passivate the steel which in turn may cause the deposits to blister or flake. Still higher chromic acid concentrations may seriously reduce the cathode efficiency of the solution until it becomes zero. Chromic acid also causes severe anode polarization and loss in anode efficiency.

Zinc Solutions

The effects of metallic impurities in cyanide zinc solutions are similar to those in cadmium solutions. Copper can deposit with the zinc and cause dullness in the deposit and prevent proper bright dipping.

The effects of chromic acid in cyanide zinc plating are very marked. As little as 0.0016 oz./gal. will affect the deposition of zinc in low current density areas and 0.017 oz./gal. of chromic acid will prevent deposition in the low current density areas (C.D. up to 1 amp./ft.^{2}). Above 0.03 oz./gal. of chromic acid, deposition of zinc is prevented up to 5 amp./ft.^{2}

The most striking example of the effects of metallic impurities was observed years ago in acid zinc deposition when it was found[11] that concentrations of germanium as low as 1 part in 10 million, or 1 oz. of germanium in 60,000 gallons of solution, produces a marked lowering of the cathode efficiency.

In acid zinc solutions,[12] copper up to 0.0027 oz./gal. did not have a serious effect and the maximum amount

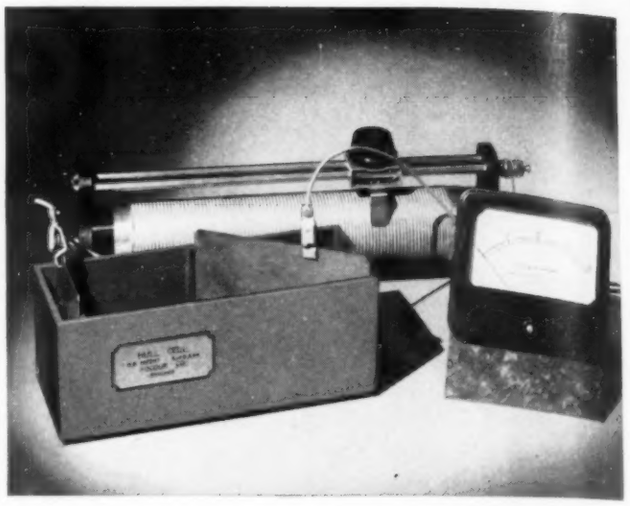


Fig. 5. Hull cell, slide wire rheostat and ammeter for studying deposits. *(Courtesy, Kocour Co., Chicago, Ill.)*

tolerated for heavy deposits is 0.0013 to 0.002 oz./gal. Higher amounts of copper caused needle-like sprouts to form before the dark color of the copper appeared. With higher copper contents, the deposits become black and spongy and current efficiency decreases rapidly. If a large amount of copper is present, it alone will deposit.

Manganese has no serious effect up to 0.13 oz./gal. Higher amounts cause holes to form. Cadmium in quantities up to 0.067 oz./gal. has no great effect. Iron up to 0.0067 oz./gal. has no effect; higher amounts decrease cathode efficiency. As little as 2 milligrams per liter of antimony (0.00027 oz./gal.) cause tree-like sprouts with a soft spongy deposit.

Acknowledgment

The writer wishes to gratefully acknowledge the kind rendering of assistance in preparing various sections of this paper, to George B. Hogaboom and Myron Diggin of the Hanson-Van Winkle-Munning Company, Matawan, N. J., and Dr. Louis Weisberg, consulting chemist of New York City.

REFERENCES

1. G. B. Hogaboom, Metal Finishing **37**, 165 (1939)
2. Myron B. Diggin, Metal Finishing **39**, 13 (1941)
3. P. Jacquet, Compt. rend. **194**, 456 (1932)
4. A. W. Hothersall, J. Electrodep. Tech. Soc. **6**, 95 (1931)
5. Walter R. Meyer and Arthur Phillips, Trans. Electrochem. Soc. **73**, 377 (1938)
6. Louis Weisberg, Metal Finishing **39**, 297 (1941)
7. M. I. Morokhov, D. V. Stepanov and S. Moroko, J. Applied Chem. (U.S.S.R.) **13**, 1322 (1940)
8. M. R. Thompson and C. T. Thomas, Trans. Electrochem. Soc. **42**, 79 (1922)
9. Russell Harr, Trans. Electrochem. Soc. **68**, 425 (1935)
10. L. R. Westbrook, Trans. Electrochem. Soc. 55, 333 (1929)
11. U. C. Tainton and Clayton, Trans. Electrochem. Soc. **57**, 279 (1930)
12. John T. Ellsworth, Trans. Electrochem. Soc. 42, 63 (1922)

Fundamentals of Science Relating to Electroplating

Chapter X. Electrical Principles

Current density is, in many ways, one of the most important terms in the language of the electroplater. It is defined as the current per unit area, and is usually expressed as amperes per square foot or per square decimeter (dm.). Actually the values regularly used have been averaged over appreciable areas and since in most cases the areas cannot be accurately measured or computed, (see Appendix to this chapter) the actual current density may vary appreciably from the computed value. In addition to this source of error, there is the factor of current distribution (throwing power) as a result of which the actual current density may vary from point to point over the area under consideration. No doubt these are some of the reasons for the lack of agreement often found in statements of permissible maximum operating current densities. Two different workers may be operating at approximately the same current density but the values of current density claimed may differ, often innocently enough, due to different estimates of the area involved.

A point that is often overlooked is that there is an anode current density as well as a cathode current density. The same general principles apply to both. Since the results of using an incorrect anode value are not so marked and are not so obvious, their importance is often underestimated. Except where practically perfectly insoluble anodes are used, for example as in the case of platinum in cyanide solutions, incorrect anode current densities will usually lead to an unbalanced solution, to the presence of undesirable impurities, ingredients or sludge, or to a combination of such effects. Instead of specifying anode current density, however, it is sufficient to specify a ratio of anode to cathode areas, since this ratio determines the relative current densities at the electrodes.

It is evident from the above that if the current passing through a reasonably small, flat, accurately measured area can be determined, the current density *in that immediate neighborhood* of the plating tank can be figured with reasonable accuracy. This is the principle on which the "cathode current density meter" is based and which is illustrated in Figure 7. The outfit consists merely of a flat piece of metal, S, for example a six inch square (¼ sq. ft. area), connected to an ammeter A and equipt with appropriate leads so that when it is immersed in the plating bath the current going through the metal piece also goes through the ammeter. This may be accomplished as in Figure 7 by cutting the hook to which the piece is fastened and inserting an insulator as between points X and Y. The hook itself is then connected to the positive side of the ammeter and the metal piece to the negative side. All submerged parts except the metal piece should be stopped-off with good insulating material. The ammeter may be calibrated so as to read directly in current density.

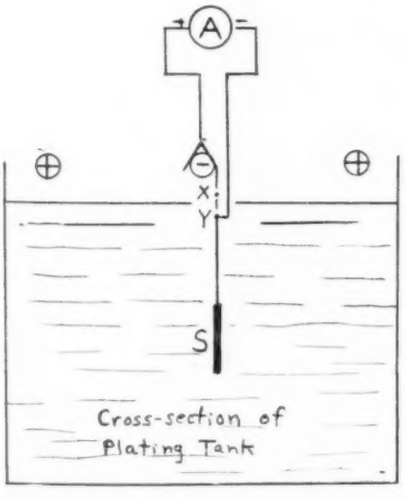


Fig. 7. Principle of current-density meter.

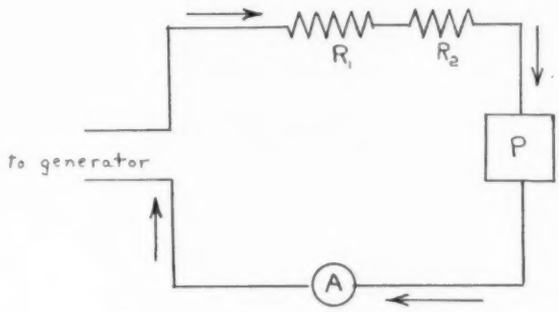


Fig. 8. Diagram of a series circuit.

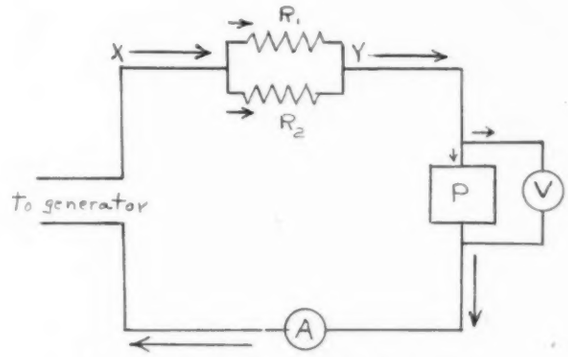


Fig. 9. Diagram of parallel or shunt circuits.

The values of current density determined in this way should be used with caution. It has already been pointed out that the value read applies only to the neighborhood in which the "test-piece" is immersed. Furthermore, however, it applies only to pieces of the same shape as the "test-piece" and may depend also on the material, on the relative shape of its metallic neighbors, on relative agitation, etc. In many cases, when intelligently used, the current-density meter will give valuable, though only approximate, information. If misused, the results can be very misleading.

Current concentration or amperes per unit volume, such as amperes per gallon, is often a convenient quantity. It determines, for example, the size of tank needed to satisfy a particular production and in certain complex plating baths the proper functioning of the bath limits the maximum current that can be passed through each gallon of solution. However, it is not used frequently and warrants no further discussion.

Ammeters and voltmeters are used so commonly that it is surprising to note how frequently the proper method of connecting

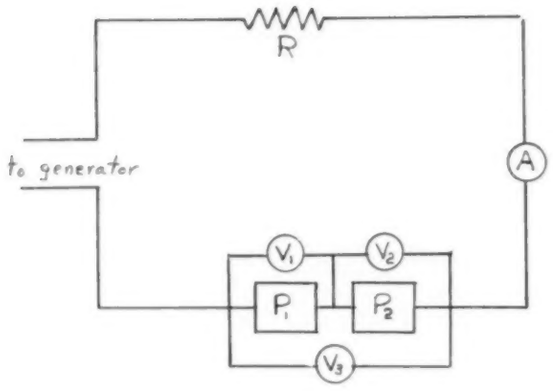


Fig. 10. Diagram of series tanks.

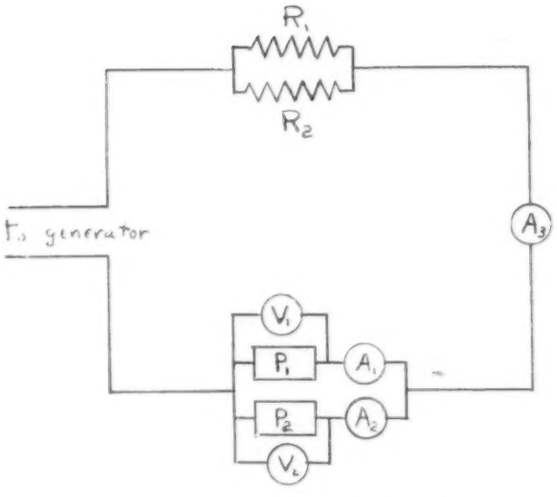


Fig. 11. Diagram of parallel tanks.

them into a plating circuit is unknown. To properly describe their connections, several other electrical terms must be introduced.

When an instrument or any electrical conductor, such as a resistor or a plating solution, is connected into an electrical circuit in such a way that all the current must pass through it, i.e., when its removal will actually break the circuit, then the connection is called a *series* connection. If the instrument or conductor is connected in such a way that it forms an *additional* path for the current, i.e., when current would flow even though it were disconnected from the circuit, then it is called a *parallel* or *shunt* connection or arrangement. Figure 8 illustrates a series circuit. "R_1" and "R_2" are resistances. "P" is a plating solution and "A" is a meter. Note that the current, as indicated by the arrow, must flow from the generator through each of the above units and back to the generator. Removing either item breaks the circuit, unless of course the loose ends are reconnected. An ammeter is always connected in series into the circuit where it is desired to measure the current. In Figure 8, "A" is an ammeter and would measure the current flowing through the plating solution, "P", or from the generator, or through the resistors "R_1" and "R_2".

Figure 9 represents a parallel circuit, "R_1" and "R_2" are again resistors, "P" is a plating tank, "A" is an ammeter and "V" is a voltmeter. The arrows show the flow of current. The total current at "X" (big arrow) splits up through "R_1" and "R_2", (small arrows), re-unites at Y, splits up again through "P" and "V" and reunites to pass through "A", the ammeter. If *either* "R_1" or "R_2" were removed, the current could still flow (undivided) through the other. Therefore, R_1 and R_2 are connected in *parallel* with each other. *Together*, however, they are connected in the general circuit in *series* for if they were *both* removed no current could flow. Similarly the plating tank "P" and the voltmeter "V" are connected in *parallel with each other* but *together* they are connected in *series* in the circuit. A voltmeter is always connected in parallel across that part of a circuit (such as a plating solution) where it is desired to measure the voltage. In Figure 9, the voltmeter "V" would measure the voltage across the plating tank. As before, the ammeter "A" is connected in series.

Figure 10 represents two plating solutions P_1 and P_2 connected in series with a resistor "R" and an ammeter "A", and three voltmeters "V_1", "V_2" and "V_3" connected in parallel as shown. In any series circuit, the total voltage between any two points is the sum of the individual voltages between intermediate points. Thus, in Figure 10, "V_1" will give the voltage across "P_1"; "V_2" will give the voltage across "P_2"; and "V_3" will give the voltage across both tanks together. The reading on "V_3" will equal the sum of the readings on "V_1" and "V_2". The same law holds true for resistances; the total resistance of a series circuit equals the sum of the resistances between intermediate points. Summarizing the situation for a series circuit: the current remains the same through all parts connected in series while the resistances and voltages of these parts add up to form the total resistance and voltage, respectively.

Figure 11 represents two plating solutions "P_1" and "P_2" in parallel, two resistances "R_1" and "R_2" in parallel, three ammeters "A_1", "A_2" and "A_3", and two voltmeters "V_1" and "V_2". The ammeters "A_1" and "A_2", being in series with the plating tanks "P_1" and "P_2", respectively, will show the current flowing through each tank. Each current will depend on the resistance of the plating solution (including electrodes, etc.), the higher the resistance, the lower being the current, in accordance with Ohm's law as described above. Since a voltmeter has a very high resistance, a very minute current will flow through "V_1" or "V_2", which may be neglected in calculations. The ammeter "A_3", in series with the main circuit, will show the current through the main circuit, i.e., from the generator, and will equal the sum of the currents shown on "A_1" and "A_2". Since "P_1" and "P_2" are connected in parallel to each other and to "V_1" and "V_2", the voltage across each will be the same and will be shown on "V_1" and "V_2". The resistances "R_1" and "R_2", which are in parallel, are no longer additive as they were when they were in series. Actually the net resistance of R_1 and R_2 combined is *less* than either one alone, according to the formula

$$\frac{1}{R_0} = \frac{1}{R_1} + \frac{1}{R_2}$$

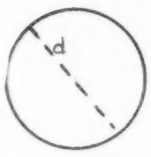
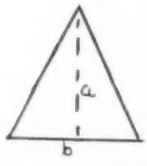
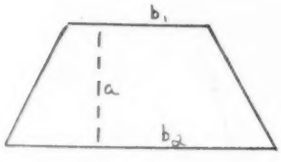
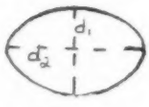
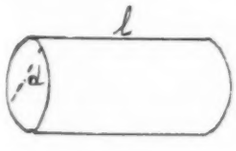
where R_0 is the net resistance of the combination of R_1 and R_2. This is the type of hook-up used in most tank rheostats whereby closing a switch throws another resistance unit in parallel with the rest, therefore *decreases* the total resistance, therefore increases the current flow. Summarizing the situation for parallel circuits: the current splits up through each parallel circuit inversely in proportion to the resistance of that circuit; the voltage remains the same across all circuits in parallel with each other; adding a resistance in parallel decreases the total resistance of that group.

APPENDIX

Relative Electrical Resistance of Common Metals, with Silver = 1.0

Aluminum	1.8	Cast iron	49-65
Antimony	2.6	Lead	14
Bismuth	7.4	Mercury	60
Brass	4.0-5.2	Monel	26
Bronze	11.2	Nickel	49
Cadmium	4.7	Phosphor bronze	3.1-6.2
Carbon	2200	Platinum	6.2
Chromium	1.6	Silver	1.0
Copper	1.1	Steel	usually 10-44
Nickel silver	21	Tin	7.2
Gold	1.5	Tin-Lead Solder	10
Graphite	500	Zinc	4.1
Iron	6.2		

COMPUTING AREAS

Figure	Name	Formula
	Circle	0.79 x (diameter)^2 = 0.79 x d^2
	Square	(Any side)^2 = s^2
	Rectangle	(Long side x short side) = l x s
	Triangle	½ x base x altitude = ½ b x a
	Trapezoid	½ x (sum of the bases) x altitude = ½ x (b_1 + b_2) x a
	Ellipse	0.79 x short diameter x long diameter = 0.79 x d_1 x d_2
	Circular Cylinder	(Circumference of circle) x (length of cylinder) = 3.1 x d x l
	Sphere	3.1 x (diameter)^2 = 3.1 x d^2

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

Luster Ware

Q. Will you please tell me with what the enclosed object is coated, and where I may obtain some of the finishing material for applying the finish.

A. This finish is commonly known as "Luster ware."

It is produced by applying a "liquid bright gold" to the glazed article, and then firing at 740° C. (1364° F.).

The liquid bright gold may be obtained from the Hanovia Chemical & Mfg. Co., 233 New Jersey R.R. Ave., Newark, N. J. The base price is $18.50 per 100 grams. Smaller lot prices are higher in proportion. As little as 10 grams may be purchased.

Instructions for the use of the material are supplied with it. —G. B. H., Jr.

Barrel Copper

Q. Can you give us any information on copper plating in a barrel over a graphite base. We have tried this and the copper deposit forms satisfactorily when the work is wired, but will not deposit in the barrel.

A. We are sorry to say we have no information on a successful method for acid copper plating in a barrel. This statement applies to all metal articles, as well as graphite coated non-metallic objects.

The adherence of a copper deposit to a graphite coating is not good enough to withstand tumbling in the second place.

If you are successful with plating your articles in a still tank it is suggested you develop a rack or some holding device for the articles, rather than wiring up, so that some approach to the economy of bulk handling could be had. —G. B. H., Jr.

Stained Gold Plate

Q. We are using a conventional cyanide gold plating solution and recently some of the work has been coming from the bath in a stained condition, which was particularly noticeable across the top of the work.

I would appreciate learning the causes for staining in gold plating and the concentration of carbonate required to cause staining.

A. To make a list of all the causes of staining, based on hear-say, would require volumes. To make a list of the causes based on actual experimental work with definite measurements will take very little time, as we know of no specific work on this subject relating to gold plating.

Your solution has been tested, and shows the gold content to be practically zero. There is considerable copper present, however. It is our belief that you are getting practically a copper deposit and that this will stain is known.

Technical Advisor For July Issue

G. B. HOGABOOM, JR.,
Consultant in Electroplating and Metal Finishing,
Newark, N. J.

Inasmuch as the solution has been in use for 1½ years with insoluble anodes, and now has probably accumulated other impurities in addition to the copper, it would be advisable to discard it and make up a new one.

Acid Copper Solution

Q. I am having trouble with my acid plating solution, which consists of copper sulphate 1¾ lbs., aluminum sulphate 1 oz., sulphuric acid 4 oz., and water 1 gal. The solution does not deposit enough copper on the item even though it is left in the solution for an indefinite length of time ranging from 1 hour to 10 hours, it still has the same thin coating and it pits leaving a rough deposit. The copper anodes seem to dissolve more than they should under normal conditions. My work is plating baby shoes; in this work I do not seem to be able to get a thick enough coat on the shoes. Please advise me how this may be remedied.

A. A satisfactory acid copper solution that is used when agitation is employed is:

Copper sulfate	33 oz.
Sulfuric acid	10 " (avoir)
Water to make	1 gal.
For still plating:	
Copper sulfate	27 oz.
Sulfuric acid	6.5 av. oz
Water to make	1 gal.

The use of addition agents such as aluminum sulfate generally appears to be attended with erratic solution performance due to the difficulty of controlling the concentration of these agents. The uncertain manner in which these agents act is also due to decomposition products they form and this further complicates their control. Large scale operations such as in the case of electrolytic copper refining have developed experience with successful use of glue in acid copper solutions but the differences between such operations and decorative plating are such that the successful use of addition agents for the latter has not been uniformly accomplished so far.

In reference to the problem of obtaining a heavy deposit in a reasonable time, install an ammeter in the plating circuit. From the table on page 10 of the 1941 edition of the Plating & Finishing Guidebook it will be seen that on a square foot of surface 17.8 ampere hours are required to deposit a coating 0.001" thick. The same table shows that 1 ampere hour will deposit on the cathode and dissolve from the anode 1.186 grams of copper and this figure can be used to determine if the rate at which your anodes are dissolving is consistent with the amperage and time of plating. The above figures are based on 100% efficiencies, but it can be assumed that actual plant conditions will be close enough to this figure in the case of acid copper plating solutions.

Recovered Silver

Q. I am enclosing a sample of silver recovered from cyanide strip cathodes, and I would like to use it in the silver plating solution.

Why do soft metal articles break out with white dots after being silver plated and scratch-brushed?

A. The powder is mostly metallic, and mostly silver. The proportion of other metals is not known. To obtain your value from this material we suggest you send it to a refiner, and use the money so obtained for the purchase of silver cyanide for use in the solution, or silver anodes. In this way you will have pure material for use in the solution.

If you desire to recover the silver from the residue yourself, dissolve it in nitric acid. Evaporate the resulting solution to dryness, to drive off excess nitric acid. The salts remaining will be mostly silver nitrate. Take up in water, and add a solution of salt (sodium chloride) or hydrochloric acid which will precipitate silver chloride. Allow the precipitate to settle, decant off the supernatant liquid, then add water and stir, to wash the precipitate. Allow to settle again, and decant. Repeat washing. The precipitating, and washing, are preferably done in a crock to allow sufficient volume.

The resulting silver chloride can then be used in the silver solution, although the use of this salt in silver solutions is falling off because it gives somewhat coarser, and harder to color deposits of silver than solutions made up with silver cyanide.

The white spots can come from some of the soap bark solution remaining in the porosity of the metal, and then picking up fines from the sawdust. Suggest you use a good grade of well riddled sawdust. The trouble may also be due to the high solids content of the water used in rinsing. This can be checked by making the final rinse in distilled water, and shaking off excess water before sawdust drying.

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

New Protective Coating

A new protective coating material known as "Miccroplastic" has just been introduced by the Michigan Chrome and Chemical Company, 6340 East Jefferson Avenue, Detroit, Mich. This new material, which is claimed to provide perfect chemical resistance against all acids and plating solutions, alkali cleaners and petroleum spirits, has characteristics which have never before been offered in similar products.

Applying protective coating to plating rack

One of the most important features of Miccroplastic is its exceptional adhesion to every portion of any metallic surface it covers, regardless of the shape or size of the plating rack, anodizing rack or other object which is coated. Even when portions of the coating are removed, there is no possibility that the solution will creep behind the coating. For this reason, the possibilities of contamination of baths by chromic acid which might be trapped under the coating is eliminated. With this protective coating material, it is always safe to go from bright nickel to chrome without reracking the work.

Miccroplastic provides the flexibility of soft rubber. It will not crack. Even when contact wires are flexed or when the entire rack is twisted and bent, the coating surface remains intact. Unlike many coatings which harden after use, this material will always retain its flexibility.

The material is very free-flowing. It is dipped easily—one dip requiring as little as five seconds for submersion and emersion. Because of this quality, Miccroplastic follows every contour and never produces webbing, bridging or air pockets.

Other important features are that it contains high solids; it dries to a high gloss which makes rinsing between baths extremely easy; and it is an excellent and permanent coating for hard chromium plating racks.

Application of the material is very simple and the only equipment required is a small, inexpensive dipping tank and a baking oven. The coating is applied directly on the metal surface which must be thoroughly cleaned. Dipping is by hand. Mechanical dipping equipment is not necessary. After quick submersion and emersion, racks are allowed to air dry for about half an hour and are then baked for one hour at 225° F. Seven coats per rack are recommended.

Wet Grinder

One of the recent developments of the Standard Electrical Tool Company, Evans & 8th, Cincinnati, Ohio, is a line of 12" and 14" heavy duty wet grinders.

The arrangement consists of wet grinding hood with integral splash bowl and adjustable work rest. Equipment on each guard includes a valve for controlling the flow of water, adjustable nozzle and suitable piping. Bottom of guard trough fitted with hose connection for gravity return of water to the tank.

A motor driven pump with tank is secured to the back of pedestal and suitable piping provided for carrying the water to each guard. The pump has capacity of 10 gallons per minute.

Both the grinder motor and pump motor are operated simultaneously through the push button safety starter at front of machine.

This machine is also available as a combination wet and dry grinder and it is for the user's selection as to whether the safety hinge door guard for dry grinding is to be located on the left hand or right hand side.

Heavy duty wet grinder

Coating for Aluminum Castings

Aluminum castings, particularly those which are subjected to low temperatures, are readily attacked by condensation of water vapor. In order to prevent this, it is

Professional Directory

G. B. HOGABOOM, JR. & CO.
Consulting Chemical Engineers
Solution analysis, plant design, process development. Testing of deposits—composition, thickness, porosity, salt spray.
352 Mulberry St. Newark, N. J.

Any plating solution analyzed for $1. Reagent solutions for analyzing available. Our representative will call on request.
Platers' Laboratory Service
P. O. Box 59, Elizabeth, N. J.

Platers Technical Service Co.
Electroplating and Chemical Engineers
Complete services, including solution analyses, process development and deposit tests.
S. C. Taormina ..... Tech. Director
Dr. C. B. F. Young ..... Tech. Advisor
Dr. G. Amorosi ..... Engr. Advisor
(Professional Engineer)
59 E. 4th St., N. Y. C. ORchard 4-1778

Metal Finishing—Rust Protection
Analysis — Testing — Consultation
Process Development—Trouble Shooting
Write for Descriptive Circular Without Obligation
Technical Service Bureau, Inc.
Consulting Chemists & Engineers
6803 No. Clark St. Chicago, Ill.

Joseph B. Kushner, Ch.E.
Metal Finishing Consultant
Plating plants streamlined for defense work.
114 E. 32nd St., N. Y. C.

★ ★

NICKEL ANODES

★ ★

Your Scrap Nickel Converted
Into New Cast Nickel Anodes
Promptly On Short Notice.

Write Quantity And Quality.

Also Buyers of Nickel Anodes Scrap, Peelings, Nickel on Brass Hangers and Baskets
Cadmium Scrap & Residues

AMERICAN NICKEL REFINING CORP.
Office 120 Lillie St., Newark, N. J.

necessary to have some form of protective coating for the casting. It has been found that an emulsion of paraffin wax and "Flexo Wax C," made with Diglycol Stearate S, can be easily applied to the castings by spraying in the cold, leaving a film of water repellent wax which completely protects the metal parts. This emulsion has also given very satisfactory results on extruded parts, alumilited sheets, zinc and tin plated parts. Further information can be obtained from the manufacturers of Diglycol Stearate S and "Flexo Wax C," the Glyco Products Co., Inc., 230 King Street, Brooklyn, New York.

New Coating Protects Life of Metals Used in Heat Treating Process

The Porcelain Enamel and Manufacturing Company of Baltimore, Md., has developed a material called Metlseel, which is said to prevent corrosion and disintegration of metal parts exposed to gaseous atmospheres at furnace temperatures. With the increasing difficulty of obtaining heat-resisting alloy steels due to priority rulings, it is believed that the product will be of interest to the heat-treating industry.

Metlseel, which is applied as a liquid coating, withstands heat in excess of 1500° F., prevents oxidation and keeps the metal parts sound and clean.

Additional information concerning Metlseel, its cost and methods of application, may be obtained by writing The Porcelain Enamel and Manufacturing Company, Eastern and Pemco Avenues, Baltimore, Md.

Protective Apron

A new protective apron, completely different from the conventional oiled duck, rubberized cloth and "synthetic" types, is announced by American Optical Company, Southbridge, Mass. The material of this new AO Protectocote is said to provide exceptionally effective protection against acids, oils and greases.

In addition to protecting the worker's clothing, the Protectocote guards his person against contact with industrial compounds and liquids that cause skin diseases and discomfort. It resists heat, will not burn. Although very tough, it is also very light in weight, assuring both comfort and durability. It's made in two styles and 11 sizes.

The Protectocote is claimed to resist the following: oils, tar, greases, acids, chemicals, paints, varnishes, lacquers, cutting fluids, solvents, kerosene, gasoline, creosote, naphtha, caustics and alkalis.

The World's Largest Rubber-Lined Fume Stacks

In the design for one of our great Defense plants was incorporated one of the most remarkable fume ducts ever put into a blueprint. The outlets for this duct system are two of these huge 80-feet-high stacks.

Ordinary insulation methods would not do for protecting this unique undertaking against the corrosive action of acid and other fumes. After a careful investigation of all the known methods and materials available, the Engineers selected the "SRL" technique of seamless-rubber-lining for the entire system.

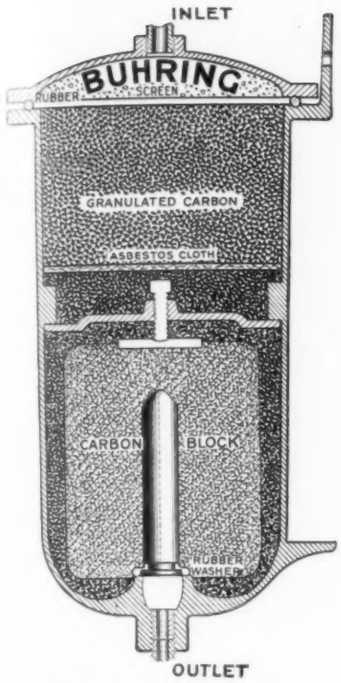
Huge fume stack covered with seamless rubber

H. Tom Collord, President of Paramount Rubber Service, of Detroit, the originator of seamless-rubber-lining, was brought into the "picture" and his firm given the contract to do the work. When completed, the job will have required in excess of a carload of latex-rubber and the insulation of ⅛" to ¼" rubber will be continuous, without a seam or a lap, from the tops of the two stacks to the furthermost reaches of the ducts.

This is said to be the largest insulation job in the entire Defense Program.

Water Filters and Purifiers

Buhring Water Purifying Co., 40 Murray St., New York, N. Y., have developed water filters and clarifiers that are recommended for purifying contaminated water previous to use in plating solutions. Several papers have been recently written telling of the effects of suspended matter and other impurities in water. The pronounced effects are roughness and increased porosity. Because of the complete clarification of the water made possible by the use of these filters, it is stated that these two troubles



Water filter and purifier

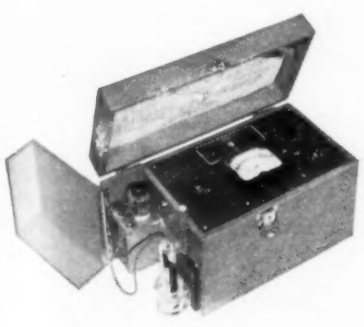
are obviated by the use of filter.

The filter is constructed of cast iron and can be protected against corrosion by porcelain lining or other covering. The filtering medium consists of two special carbon blocks, in each cylinder, which are superimposed and attached to the cover. The cleaning operation is simple and consists only in the manipulation of the distributor valve by turning the lever over to the various indications marked on the dial. Capacities are from 10 to 20 gallons per minute depending upon whether coarse or fine carbon blocks are used and on the available water pressure.

Buhring Water Purifying Company will be pleased to make recommendations for filtering water previous to plating.

New Glass-Electrode pH Indicator

Though simplified and stripped to essentials for low cost and easy operation, Leeds & Northrup's *new* Glass-Electrode pH Indicator offers as much accuracy as is needed in many laboratory measurements and in practically all plant tests. It retains full accuracy up to 85°F in atmospheres of 95 per cent relative humidity. Measurements can be made consistently within its limit of error of adjustment, ±0.1 pH.



Glass electrode pH meter

Light in weight, well balanced, it includes everything necessary for measuring pH. Speed and convenience are inherent in its simple construction. Adjustments take but a moment. Measurements are made simply by pouring a sample into its self-contained beaker, and reading pH directly from the meter scale.

Adequately shielded, the instrument embodies a rugged deflection meter, and a thermionic amplifier of high stability. Manual temperature compensator (0 to 50° C, with 1-degree divisions) eliminates computations, saves time, prevents errors. Factory filled and sealed electrodes are highly stable. Strong, well-finished, mahogany case, of special construction, stands severe use and high humidity.

An 8-page illustrated catalog describing this new indicator is available, and has been sent to many sections of the L&N mailing list. If you failed to receive a copy, ask Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pa., for Catalog E-96(2).

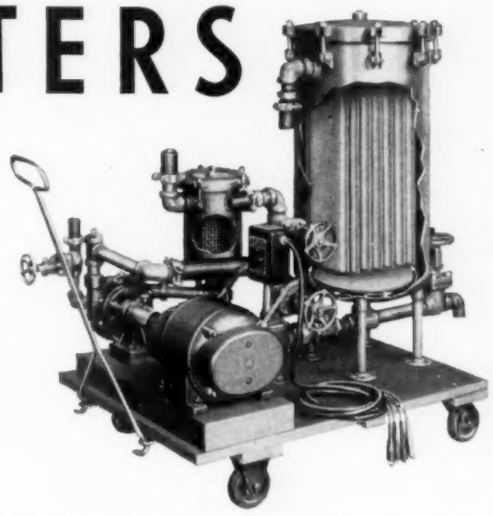
New Lubricants for Aluminum

Wayne Chemical Products Co., 9600 Copeland St., Detroit, Mich., have announced the development of two new products for lubricating aluminum. One product, the company's No. 4 aluminum drawing oil, is a viscous lubricant that is claimed not to squeeze out under great pressures exerted in deep drawing of thin sheets of aluminum. The manufacturers state that it has been recently adopted by several large press plants now working on defense orders, especially airplane body parts, large cooking utensils and the like.

FILTERS

For

Bright Nickel
Nickel
Chrome
Copper Sulphate
Cyanide Copper
Brass and Zinc
Cadmium
High Speed Copper
Brite Zinc
Silver
Electrocolor
And Others



INDUSTRIAL FILTERS will do a fine job of filtering and purifying your plating solutions, at the lowest possible cost per filtered gallon.

INDUSTRIAL FILTERS have larger filter areas, more sludge holding capacity and higher pressure pumps, which insures high flow rates and longer filter cycles.

The "LEAK-PROOF", "CORROSION-PROOF" and non-contaminating construction of Industrial Filters is a vital requisite of Electroplating filters.

SALT SPRAY

CORROSION TEST EQUIPMENT

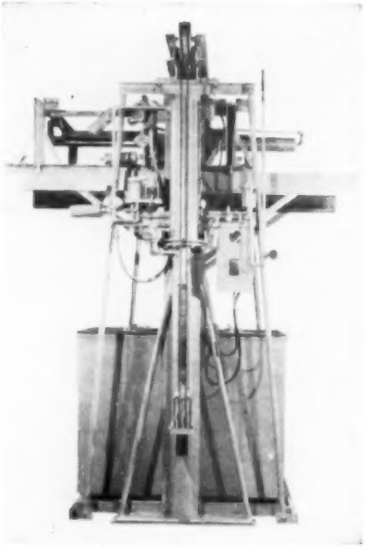
For testing—Electroplated or coated metals at 95 deg. Fah. in accordance with Army, Navy and Aeronautical specifications, as outlined in Bulletin AN-QQ-S-91-5 dated Dec. 1938. Also for controlled temperatures at any degree. Testing Cabinets lined throughout with rubber. Made in 4 sizes.

"Write for NEW Literature and particulars."

INDUSTRIAL FILTER & PUMP MFG. CO.

3017 WEST CARROLL AVENUE **CHICAGO, ILLINOIS**

Crown Pick-up Unit



...MACHINE...

A UNIT TYPE TRANSFER CAPABLE OF HANDLING SEVERAL TANKS AT ONE TIME.

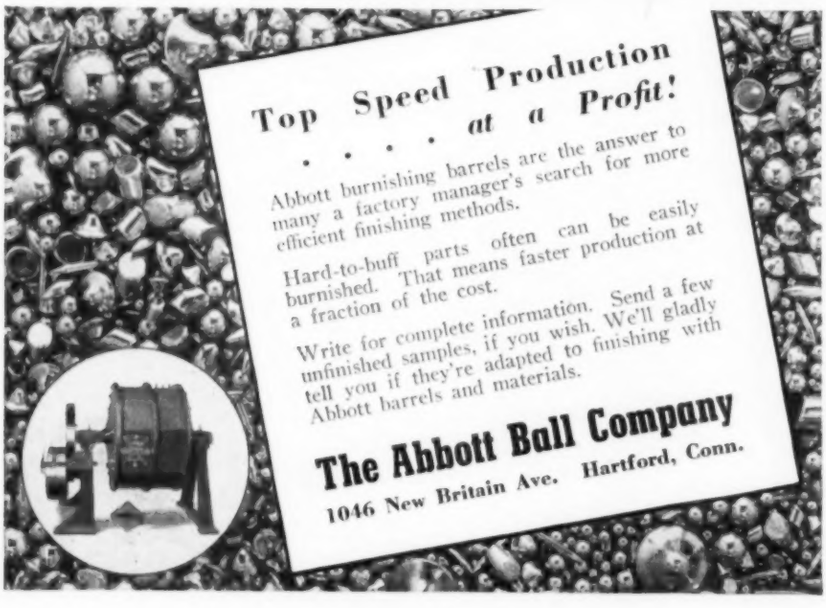
●

...USE...

FOR A SERIES OF OPERATIONS WHERE THE WORK MUST PASS THROUGH SEVERAL TANKS, AS THE CLEANING AND RINSING OPERATIONS, FOR A SEMI-AUTOMATIC PLATING TANK.

CROWN RHEOSTAT & SUPPLY CO.

1910 MAYPOLE AVENUE :-: :-: CHICAGO, ILLINOIS


Top Speed Production
. . . . at a Profit!
Abbott burnishing barrels are the answer to many a factory manager's search for more efficient finishing methods.
Hard-to-buff parts often can be easily burnished. That means faster production at a fraction of the cost.
Write for complete information. Send a few unfinished samples, if you wish. We'll gladly tell you if they're adapted to finishing with Abbott barrels and materials.
The Abbott Ball Company
1046 New Britain Ave. Hartford, Conn.

The other product, the company's No. 2 aluminum cutting oil, is stated to be a very thin oil that provides the necessary lubricating properties to insure the highest type of machining, perfect threads, clean holes, etc.

Free samples will be sent to interested metal working plants upon request.

Cutting and Grinding Base Compound

Announcement is made by The Curran Corporation, manufacturing chemists, that water soluble cutting and grinding compound may be prepared from its Gunk P-96 Concentrate by the simple addition of 3 volumes, of light lubricating oil and a low-cost petroleum distillate. A variation of the quantity and type diluent used will result in a skilled operator's being able to prepare "tailor-made" water soluble cutting and grinding lubricants to fit each particular job at hand.

According to the manufacturer's chemical laboratory, the preparation of superior water soluble cutting and grinding compositions is very simple, being only necessary to stir ordinary light lubricating oil with the concentrated liquid Gunk.

Such composition may be diluted with approximately 10 volumes of water to form stable milky emulsions or clear transparent solutions of high water content and cooling properties may be made.

In addition to the finer grinding results stated to be obtained on certain metals and jobs, the concentrated Gunk is said to impart to the emulsion, by virtue of its alkyl phenol content, a definite sanitizing and sterilizing action on all surfaces. The cutting and grinding emulsions obtained are also said to leave ferrous metal surfaces inhibited and resistant to the forming of rust.

Electric Timer

The Precision Scientific Company, 1750 N. Springfield Avenue, Chicago, announces a new electric stopwatch, known as "TIME-IT" Minute Model, run by a synchronous electric motor which operates a direct reading indicating counter. Accuracy is covered by the cycle constancy of 115 volt A.C. current supply. The device integrates to 1000 minutes, reading in full minutes and hundredths of a minute. It can be reset to zero from any reading, or successive readings can be totalled. Applications include laboratory procedures, time study operations, timing of long distance telephone calls, motor dynamometer tests, etc.

Electric timer

New Abrasive Mask

Production of its new "No. 602 Healthguard Abrasive Mask" is announced by Chicago Eye Shield Company, designer and manufacturer. Recently tested and approved by the U. S. Bureau of Mines (Approval No. 1918), the new mask is said to be especially attractive to those industries in which harmful dusts of intense or lesser density are encountered during periods of extensive exposure, particularly in sandblasting operations. A special advantage is claimed in that low operating pressure of 2 to 9 pounds per square inch result in full efficiency and low cost operation.

The mask consists of a soft moulded rubber facepiece with large replaceable laminated glass lenses, headharness and corrugated tube, filter unit with replaceable cartridge, air-regulating valve, pressure-relief valve, quick-acting detachable coupling and approved hose which connects it to the air supply. In use, the mask is completely covered by the new pure gum rubber Duratex Hood for protection of the head, neck and shoulders. The hood lens holder is fitted with an inner laminated glass window and an outer screen of course metal.

In operation, the air under regulated pressure passes through the filter cartridge where foreign particles and odors are removed. Control valve regulates the flow of clean air to the facepiece, excessive pressure is said to be entirely eliminated by a fully automatic relief valve.

Incoming air strikes a baffled wall upon entering the facepiece to accomplish more even distribution and circulation of the air supply, which, in turn, promotes comfort, coolness and normal respiration. Exhaled air is released through a one-way exhaust valve which prevents dust-laden air from entering the facepiece, the released air circulating within the outer hood. Further details on the new No. 602 Abrasive Mask are obtainable from Chicago Eye Shield Company, Dept. 62, 2362 Warren Blvd., Chicago, Illinois.

Manufacturers' Literature

Anodic Alkaline Cleaner

MacDermid, Inc., Waterbury, Conn., have just issued an illustrated 4-page folder in color describing "Anodex," their alkaline material for anodic cleaning of steel. This material is stated to clean fast and economically and to leave the parts smut-free. It is used with from 6 to 12 volts direct current and is stated to eliminate pre-cleaning operations.

Deodorant

An illustrated bulletin of *Oakite Products, Inc.*, 22 Thames St., New York, describes "Oakite Deodorant No. 1," which is stated to clean, deodorize and disinfect, and is recommended for wash rooms, lavatories, locker rooms, shower stalls, etc. It does not mask or replace one odor with another but is stated to leave the surface clean and odor-free.

No Waste of Metal

WHEN YOU USE

MICCROPLASTIC

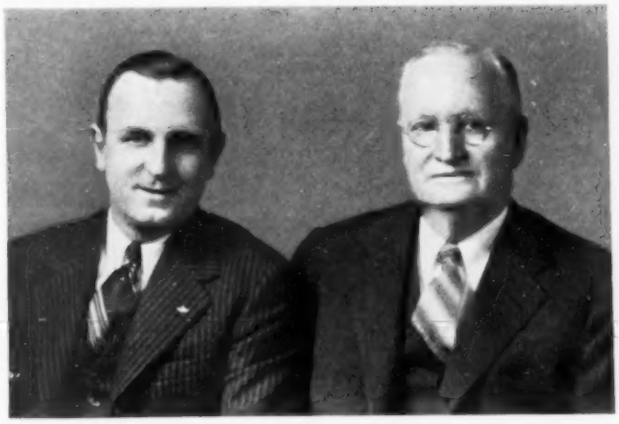
With plating metals occupying a top rank on the priorities lists, you can't afford to waste them. Miccroplastic is the new protective coating material which provides a positive method of reducing to an absolute minimum any waste of metal in plating operations.

Miccroplastic adheres firmly to every portion of any metallic surface it covers eliminating the possibility of the solution creeping between the coating and the rack even if, by accident, a portion of the rack is exposed. It is extremely flexible, and will not crack when the coated rack is twisted or bent, as illustrated. It resists all acids and plating solutions, alkali cleaners and petroleum spirits. Because of characteristics such as these, Miccroplastic provides *exceptional* protection. Plating racks on which Miccroplastic is applied can be used over a long period of time and never accumulate metal except at points which have been purposely exposed, as in the case of the contact points of the rack illustrated.

Other features of Miccroplastic are its unusually low viscosity . . . . high solids . . . . easy application . . . . and adaptability for use even as a permanent coating for hard chromium plating racks.

WRITE FOR COMPLETELY DESCRIPTIVE LITERATURE

MICHIGAN CHROME & CHEMICAL CO.
6348 EAST JEFFERSON • DETROIT, MICHIGAN



FATHER AND SON IN BUSINESS

On the left above is Harry Harrison, son, and on the right is Richard C. Harrison, father of Harry. The elder Harrison manufactured abrasives from 1887 to 1922 both in England and St. Johns, New Brunswick, Canada. In 1922 he began to specialize in compounds for polishing steel at which time Harry joined him. Their association is now known as Harrison & Co. which company specializes in cutting-down, polishing, and mirror finishing compounds.

AS BUSY AS A ONE-MAN BAND!

Wyandotte MK 50 Solvent Detergent is turning in spectacular results on many different kinds of metal cleaning jobs. Here are a few of the operations this one all-around compound can complete at low cost:

MK 50 will clean cold rolled steel stampings prior to painting and lacquering—clean stainless steel after stamping and drawing —clean brass after machining, aluminum castings prior to anodizing, and die castings and special alloy steels after machining.

That's an example of one Wyandotte metal cleaner for many jobs. And there are many Wyandotte Compounds specially built for one special kind of work.

Your Wyandotte Service Representative will be glad to show you which Wyandotte Products you need in your shop. Call him today.

Wyandotte PRODUCTS

Service Representatives in 88 Cities

THE J. B. FORD SALES CO.
WYANDOTTE, MICHIGAN

Glass-Electrode pH Indicator

Catalog E-96(2) 1941. *Leeds & Northrup Co.*, 4907 Stenton Ave., Philadelphia, Pa. An 8-page folder describing the company's glass-electrode pH meter. The meter is claimed to be simple to operate and offers a temperature compensator and convenient overlap of 2 pH in the region of the neutral point. It has two calibrated scales—0 to 8 and 6 to 14 pH. The instrument is sturdy and portable and is accurate to within ±0.1 pH.

Munitions Cleaning Handbook

Magnus Chemical Co., Inc., Garwood, N. J., have just issued a new 36-page, illustrated "Munitions Cleaning Handbook." The handbook discusses in detail the cleaning problems met with in modern munition production. It covers cleaning operations in the manufacture of shells, shell cases, small arms ammunition and fuses and fuse parts. Another section of it covers the cleaning operations required in the production of ordnance, transportation equipment and other material which must be built to meet the complex and extensive demands of the Defense Program. The methods and materials discussed in this section are applicable in solving the cleaning problems encountered in any modern metal processing plant. The book also devotes space to cleaning in maintenance and repair shops and the cleaning and protection of workers' hands and skin. Copies of the book can be obtained by writing to the above company, Dept. M.

Recording Voltmeters and Ammeters

Bulletin No. 574 of *Bristol Co.*, Waterbury, Conn., describes and illustrates the company's portable recording ammeters and voltmeters. Constructional features are graphically shown and charts depicting actual recordings are reproduced.

Surface Preparation for Spot Welding

In the May-June 1941 issue of *Oakite News Service*, published by *Oakite Products, Inc.*, 22 Thames St., New York, the important part that proper cleaning and surface preparation play in electrical resistance spot-welding of aluminum and its alloys in connection with aircraft production, is described in an interesting two-page feature article. Copies of this illustrated, concise article are available to production executives upon request.

New Books

Lessons in Arc Welding, published by The Lincoln Electric Co., Cleveland, Ohio; 176 pages, 6 x 9 inches; 170 illustrations, including photos and drawings; cover—semi-flexible simulated leather, gold embossed; price 50 cents per copy, postpaid anywhere in U. S. A., 75 cents elsewhere.

This book makes available to industry and to engineering colleges and universities, also trade and vocational schools, the accumulated welding instruction information from The Lincoln Welding School, which has been in continuous operation for 24 years. It has become, in its early edition, the standard text book of educational institutions throughout the country which now include courses in arc welding as a regular part of the curriculum.

Helpful to beginners learning to arc weld, also to experienced welders desiring its comprehensive practical information, and to welding officials, such as supervisors, foremen and instructors, as well as others interested in the subject, the book comprises a ready reference on arc welding and a guide to its proper application. It will be found invaluable, at this time, to any industrial organization faced with the necessity of training its own welders to meet demands imposed by the National Defense program.

Lessons in Arc Welding is a series of 60 lessons which present, in concise manner, fundamental facts of welding, knowledge of which will enable the welder to utilize the process successfully and economically.

Beginning with an introduction giving preliminary instruction to the welder, including suggestions for making and following a definite plan for learning the fundamental principles of arc welding, and for practicing continually, examining

welds, criticizing and inviting criticism of work, for wearing proper protective apparel at all times, and assuming proper working positions the lessons cover all pertinent details for the welding of both ferrous and non-ferrous alloys.

Text explanations are graphically supplemented by by-line drawings and photos for ready understanding.

A valuable feature of the book is the set of questions and answers for each lesson enabling the student to check his knowledge. This question and answer section is contained in 25 pages, with 18 pages of questions and 7 of answers. Since the questions are headed by the lesson number and subject matter, they can be of assistance in furnishing the solution to problems. Knowing the subject matter, the student can refer to the index, find the lesson in which it is covered, then turn to the questions on that particular lesson in the back of the book.

Lessons in Arc Welding may be obtained directly from The Lincoln Electric Co., or through any of its branch plants, dealers or representatives, or through any recognized book dealer.

Technical Publications

A Bibliography of Indium (1934-1940)

Compiled by *Maria Thompson Ludwick.* Indium Corp. of America, 805 Watson Pl., Utica, N. Y.

This bibliography was compiled from reference books, other bibliographies and chemical journals. Subject matter includes: Occurrence and Extraction of the Element, (a) Optical Properties; Spectroscopic, X-Ray and Sub-Atomic Data; (b) Electrical Properties; (c) Miscellaneous Physical Properties: Atomic Weight, Hardness, Thermal Properties, etc.; Qualitative and Quantitative Analysis; Alloys; Chemical Properties, Compounds and Properties of Compounds; Miscellaneous Information: Cost, Commercial Production, Uses, Physiological Action, Bibliographies, Bulletins, General References.

1940 Supplement Bibliography of Indium has also been issued covering the literature up to the end of 1940.

Metallic Grains—In Three Dimensions

By *D. D. McGrady.* Michigan Engineering Experiment Station, E. Lansing, Mich. Bulletin No. 90, September 1940. Price: 25c.

The fact that grains of metals do exist in three dimensions has long been known and accepted. In the usual method of microscopic observation, however, only a single plane surface is considered and the "depth" factor of the grains merely assumed. This is undoubtedly a convenient and wholly reasonable procedure and seems to be quite logical to most students of the subject.

Nevertheless it is not unusual to find students who have difficulty in visualizing the three-dimensional aspect of the plane surface which they are viewing under the microscope. It is possible to help such students by making a three-dimensional sketch of their metallographic sample and by explaining to them that the observed plane surface cuts at random through the grains of the metal.

Quite often a "drawing" of an edge of a sample showing the same grain existing on both faces will help in the explanation. With the proper procedure the students can microscopically observe an edge of their own metallographic specimen and see for themselves the actual existence of this "drawing."

The direct experimental study of the methods of observing the existence of depth of grains in metals is the subject of this discussion.

Welding of Copper and Copper Alloys

"Chase Welding Rods" is the title of a handbook issued by *Chase Brass & Copper Co., Inc.*, Waterbury, Conn., that outlines the more recent advances made in the art of welding copper and copper base alloys by both the oxyacetylene and carbon arc methods. Outstanding new developments are the welding of red brass and copper by both methods of welding, also the use of copper and copper alloy welding rods in the welding of steels. It is of particular interest to note the broad application of Olympic bronze welding rod for the carbon arc welding of numerous alloys.

The compositions of the company's various types of welding rods are given together with their descriptions of each type of alloy. The description mentions such factors as melting point, density, strength and special uses. Suggested set-ups are graphically shown for welding of joints.

This book can be secured free of charge by writing to the Chase Brass & Copper Co., on company letter-head.

Engineering Properties of Inconel

Bulletin T-7 Revised as of February, 1941. Technical Information, Monel, Nickel and Nickel Alloys. Development and Research Division, *International Nickel Co., Inc.*, 67 Wall St., New York.

This bulletin gives valuable technical in-

CHECK THESE ADVANTAGES OF USING NUCHAR ACTIVE CARBON

✓ IMPROVES QUALITY OF PLATING
✓ AVOIDS THE NECESSITY OF EXTRA BUFFING
✓ ELIMINATES A TENDENCY TO BRITTLENESS IN PLATED NICKEL

Periodic treatment of plating solutions with NUCHAR Active Carbon will avoid unnecessary loss of time and expense due to extra buffing operation which may be the result of plating with contaminated solutions. NUCHAR Active Carbon is now being used by a large number of electro-platers for removing these objectionable impurities quickly and inexpensively from plating solutions. Write for complete information on application and type of NUCHAR Active Carbon recommended.

ACTIVE NUCHAR CARBON

INDUSTRIAL CHEMICAL SALES
DIVISION WEST VIRGINIA PULP & PAPER COMPANY
230 Park Avenue - - - New York

Have You a Metal Cleaning EMERGENCY?

MANY plants on defense production are suddenly confronted with new metal cleaning jobs. We have solved dozens of tough, new problems successfully.

Cowles Metal Cleaners meet present day demands . . . they save time, speed up production and are economical.

If you have a cleaning emergency call for Cowles dependable, economical metal cleaners. There is a Cowles Cleaner for every job—and they are all backed up by Cowles Technical Service, which is our assurance that:

"Cowles Metal Cleaners will get you out of trouble and keep you out of trouble."

COWLES CLEANERS

THE COWLES DETERGENT CO.
Metal Cleaner Department
7016 Euclid Avenue Cleveland, Ohio

"Cleaner Surfaces for Better Finishes"

formation on Inconel which is an alloy composed, roughly, of 79% nickel and 13% chromium with small amounts of copper, iron, manganese and silicon. Tabular data are given on mechanical property ranges of standard products and limiting mechanical properties. Physical constants, such as density, melting point, specific heat, ductility, compressive properties and shear properties are given. Extensive information is presented on the resistance of Inconel to corrosive conditions and this metal was developed originally to resist corrosion and tarnishing by foods. Inconel's resistance to fresh water, salt water, oxidizing acids, mineral acids, alkalies and various gases are described. Working properties are discussed in detail and various applications of Inconel are illustrated.

Tin Plate Manufacture A Bibliography

Compiled by *V. S. Polansky*. Technology Dept., Carnegie Library of Pittsburgh.

A thorough bibliography of factors in the manufacture of tin plate is given. The references are arranged alphabetically according to the authors' names. Photostatic copies of any of the articles listed can be supplied by the Carnegie Library of Pittsburgh, Pa.

Copper and Copper Alloys For the Process Industries

Revere Copper & Brass, Inc., 230 Park Ave., New York.

Chemical and physical properties of the company's copper alloys are given. The corrosion resistance of copper, brass, bronzes, to various types of atmospheres met with in the process industries, are described and illustrated. Tube sheets, condenser tubes, brass and copper pipe are described in detail. Welding of copper alloys for use in the process industries is discussed.

Copper and Copper Alloys For the Mechanical Industries

Revere Copper & Brass, Inc., 230 Park Ave., New York.

An illustrated book giving technical information such as chemical and physical properties of copper alloys as made by the company. Various types of copper are first discussed, and following this, brasses are described. Bronzes, cupro-nickel and nickel silvers are included. Specific applications of the various copper base alloys are described and illustrated.

Copper and Copper Alloys For Power Plants

Revere Copper & Brass, Inc., 230 Park Ave., New York.

The physical properties and applications of copper alloys used in power plants are described. Alloys discussed include cupro-nickel, red brass, Muntz metal, arsenical copper and several trade name alloys. Some of the uses for copper alloys are condenser tubes, tube sheets, water tubes and pipes. Data on welding of copper are given.

Influence of Stress on the Corrosion Pitting of Aluminum Bronze and Monel Metal in Water

By *Dunlap J. McAdam, Jr.* and *Glenn W. Geil*. Research Paper RP1366. National Bureau of Standards, Washington, D. C. Part of Journal of Research of the National Bureau of Standards, Volume 26, February 1941.

Cyclic stress tends to increase the size and sharpness of corrosion pits in aluminum bronze and Monel metal and thus tends to increase the rate of lowering of the fatigue limit by corrosion. The form of corrosion pits in aluminum bronze is affected by the duplex microstructure. Pits in Monel metal are not appreciably influenced by the microstructure. Curves of decrease of the fatigue limit, and constant damage diagrams derived from these curves, are very different from those obtained with steels. These differences may be attributed to the fact that the rate of corrosion of aluminum bronze and Monel metal, unlike that of steel, is anodically controlled. Steady stress tends to increase the rate of corrosion pitting of aluminum bronze but has little apparent effect on Monel metal.

Associations and Societies

Electrochemical Society

At the Fall meeting of the Electrochemical Society to be held at Hotel Knickerbocker, Chicago, Ill., October 1-4, 1941, "A Symposium on Electroplating" will take place. Three technical sessions will be devoted to nineteen papers discussing principles and modern practice in the electroplating field.

The papers and discussion will be published in a separate volume which will cover approximately 400 pages, and this volume is being offered at a pre-publication price of $4.50. Orders should be placed directly with the Electrochemical Society, Columbia University, New York, N. Y. The regular price of the volume will be $5.50.

Outstanding authorities have prepared papers for this Symposium. The following is a tentative list of subjects and authors:

1. General Principles and Methods of Electroplating—Wm. Blum, A. O. Beckman, Walter R. Meyer.
2. Brass—H. P. Coats.
3. Cadmium—L. R. Westbrook, K. G. Soderberg.
4. Chromium—G. Dubpernell.
5. Cobalt—K. G. Soderberg, W. L. Pinner, E. M. Baker.
6. Acid Copper—J. H. Winkler.
7. Nickel—K. G. Soderberg, W. L. Pinner, E. M. Baker.
8. Cyanide Copper—A. Kenneth Graham, H. J. Read, C. J. Wernlund.
9. Gold—J. Kushner.
10. Iron—C. T. Thomas.
11. Lead—Wm. Blum, A. G. Gray.
12. Platinum—J. Kushner.
13. Rhodium—J. Kushner.
14. Silver—N. E. Promisel, D. Wood.
15. Alkaline Tin—F. F. Oplinger, F. Bauch.
16. Acid Tin—P. R. Pine.
17. Cyanide Zinc—R. O. Hull, C. J. Wernlund.
18. Acid Zinc—E. H. Lyons.
19. Alloy Plating—C. L. Faust.

R. O. Hull is Chairman of Electrodeposition Division.

American Electroplaters' Society

Los Angeles

The formation of a Ladies' Auxiliary of Los Angeles Branch was recommended at the June 11 meeting by Bruno H. Schindler. Sentiment, on the whole, was favorable to the proposal, providing the ladies were agreeable to such a step. President Don Bedwell appointed a committee consisting of Mr. Schindler and Sergeant-at-Arms Carroll McLaren to poll the fair sex on the question.

A committee was also named to direct arrangements for the branch's annual picnic which will be held Sunday, July 20, in City Park, Montebello, Calif. Appointed to the picnic committee were Earl Coffin, Emette R. Holman, Bruno H. Schindler, Stanley Rynkofs, Gilbert Bishop, Ray Vasquez, D. N. Eldred, Clarence Thornton, Ervin Frauenhoff, Charles Russell and E. R. Cahoe.

Manuel Sanz, process engineer of the Vultee Aircraft Co., Downey, Calif., presented a paper dealing with a method of analyzing chromic acid baths used for the anodizing or chromatizing of aluminum and its alloys.

The branch will hold no meetings in July and August, the next monthly session being scheduled for September 10.

Obituary

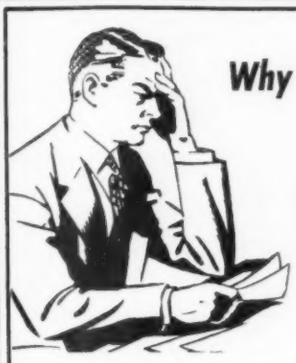
J. F. Roche, Jr.

J. F. Roche, Jr., died on May 28th from complications following an emergency appendectomy.

Mr. Roche was born in Billings, Mont., on July 28, 1905, and was the oldest of nine children. He graduated from high school in Chicago and received his college education at the University of Notre Dame (Engineering School), South Bend, Ind. His business career started in the planning department of the Edison General Electric Appliance Co., Chicago. His permanent connection with the Binks Mfg. Co., Chicago, Ill., began in November 1935. His efforts were devoted to the building up of the Industrial Division of the company. He traveled all over the country in pursuit of his work, and on April 26, 1938, was elected a director and vice-president of the Binks Mfg. Company.

He is survived by his widow, Elizabeth Barrett Roche, and by three children, J. F. Roche III, Elizabeth and Patrick, Mr. and Mrs. Roche, two brothers and six sisters. His greatest happiness was his family and his home at 620 Franklin St., River Forest.

Testimonials of high regard have come from countless friends and associates in the form of masses, flowers, telegrams and letters. The large attendance at the church and the mile-long caravan of cars to All Saints Cemetery bespeak the high esteem in which Mr. Roche was held by men and women from all walks of life.



Why Worry About Metal Shortages When You Can Use

EBONOL

Reg. U. S. Patent Office

THE JET BLACK CORROSION RESISTANT FINISH FOR IRON AND STEEL

Check These Features:

- Fast Blackening by Immersion in Only ONE Bath
- Deep Penetration — No Red Stains
- Highest Corrosion Resistance
- Simple and Economical to Operate

We are confident that EBONOL is *the* outstanding blackening process for iron and steel and all we want is an opportunity to prove this to you. Hundreds of parts now being made of brass, aluminum, or zinc and lacquered, enameled or plated, can be advantageously made of EBONOLIZED STEEL. Haircurlers, trunk hardware, guns, fan parts, pencil parts, tools, toys, bearing races, electrical apparatus, electrical appliances, switch parts, clock parts, pins, lamps, drapery hardware . . . .

LET OUR FINISHING ENGINEERS SERVE YOU

Send sample parts for finishing or tell us your problem

The ENTHONE Co.

New Haven, Conn.

Specialists Since 1930 in Finishing Materials and Processes

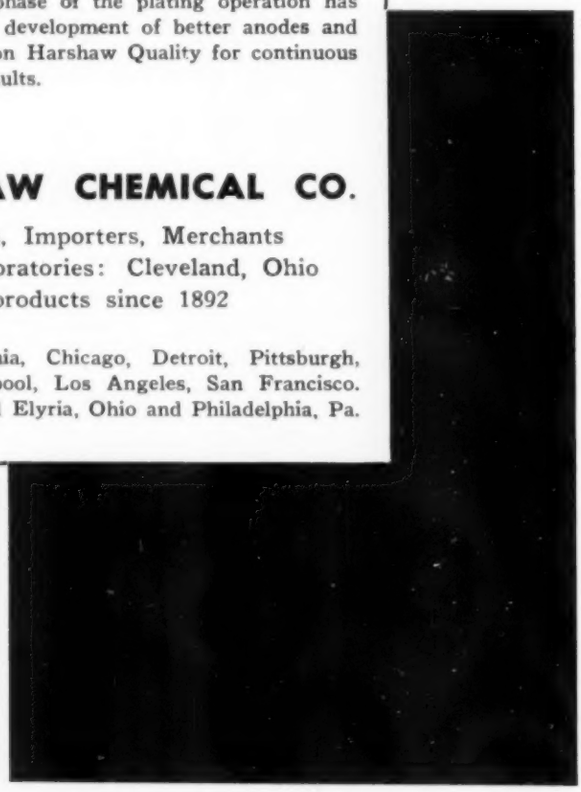
BACKED BY EXPERIENCE

Harshaw anodes and chemicals are produced by tried and proven methods of manufacture—methods developed through thirty years research in cooperation with customers . . . Every phase of the plating operation has been considered in this development of better anodes and chemicals . . . Depend on Harshaw Quality for continuous production and best results.

THE HARSHAW CHEMICAL CO.

Manufacturers, Importers, Merchants
Offices and Laboratories: Cleveland, Ohio
Quality products since 1892

New York, Philadelphia, Chicago, Detroit, Pittsburgh, Cincinnati, East Liverpool, Los Angeles, San Francisco. Works at Cleveland and Elyria, Ohio and Philadelphia, Pa.



Personals

P. C. Stryker Now with O. Hommel Company

The O. Hommel Company, Ceramic Suppliers, Pittsburgh, Pennsylvania, announces the addition of *Phillips C. Stryker* to their sales and service department. Mr. Stryker is well known throughout the ceramic industry and his many friends will be pleased to learn of his new association.

Mr. Stryker was employed in the Research Department of the General Electric Company, Schenectady, New York, during the years 1925 to 1928. In September of 1928 he joined the Hanovia Chemical and Manufacturing Company as sales representative. He was sent to England by that concern in 1933 to establish sales outlets for Hanovia and introduce their products to the British industry. Mr. Stryker's official connection with the O. Hommel Company began on May 1.

Ernest M. Hommel New O. Hommel Company President

At the annual meeting of the directors of *The O. Hommel Company*, ceramic suppliers, Pittsburgh, Pennsylvania, *Ernest M. Hommel* was elected to the presidency of that company to fill the vacancy occasioned by the death of his father, *Oscar Hommel*.

Mr. Ernest Hommel has been actively associated with the concern he heads for the last 18 years as a sales representative, and since 1929 has been vice-president.

Dr. J. D. Clark Joins Glyco Products

Dr. Joseph DuBose Clark has been appointed Chemical Director of *Glyco Products Co., Inc.*, Brooklyn, N. Y., where he will be in charge of research and development.

Dr. Clark was graduated from Clemson College with the degree of B.S. in Chemical Engineering and later received his M.S. and Ph.D. in Physical Chemistry from Syracuse University.

Dr. Clark first served as a textile consultant and with the U. S. Army Engineers, and later with the Chemical Warfare Service in World War I. Later he was chemical inspector for the State of South Carolina. Then he taught at Syracuse University for seven years before engaging in industrial research and development with the Firestone Tire & Rubber Co., Kalamazoo Vegetable Parchment Co., Lambertville Rubber Co., Hercules Powder Co., Flood & Conklin Mfg. Co., and the Nixon Nitration Works.

Dr. Clark is especially versed in applications of the newer chemicals, resins and waxes to the paper, rubber and coating industries. He has spent the last three years working out special application problems, not only in the laboratory, but at the plants of many manufacturers in the East and Middle West. In this way, he has made many friends who will be glad to know of his new position.

Milton Nadel Joins Special Chemicals Corp.

Lionel Cinaman, president, *Special Chemicals Corp.*, 30 Irving Place, New York, N. Y., has announced that *Milton Nadel* has joined his company on June 16th as installation and service engineer. He will also do research investigations and development work.

Milton Nadel

Mr. Nadel secured his technical education at Brooklyn Polytechnic Institute, and for the past four years has been plating supervisor at James B. Williams Company, Brooklyn, N. Y.

G. Dewey Spies has been added to the technical sales force of the *Quaker Chemical Products Corp.*, Conshohocken, Pa., in the northern Ohio territory. Mr. Spies is a trained metallurgist, who was formerly associated with *Republic Steel Corp.*, *Timken*

Roller Bearing Co., and *U. S. Steel Corp.* He is thoroughly conversant with the various phases of metal processing, such as drawing, forming, machining, heat treating, cleaning and similar work. Mr. Spies has established headquarters at 320 Beech St., Berea, Ohio.

New Vice Chairman of International Fellowship Club

Charles E. Schlott was elected, in Boston, to the first vice-chairmanship of the International Fellowship Club.

He was born in New York City 51 years ago and started to work for the Egyptian Lacquer Mfg. Company 36 years ago. On July 5, 1905, he took Ben Popper's place as office boy and worked around the office until 1910, at which time he joined the sales force of the company, and has been employed in that division ever since, covering Metropolitan New York and a small part of Central New York.

Charlie has attended every A.E.S. convention since 1921 and hasn't missed a Fellowship luncheon since they were organized. He is a member of the New York Branch of the A.E.S., and has served on various committees including that for the recent testimonial dinner to Ben Popper. Charlie is very popular in the trade and has built up an extensive friendship among electroplaters and finishers, both in New York and elsewhere. He is happily married and his wife is also popular among the A.E.S. membership. He, incidentally, is the third Egyptian Lacquer Mfg. Company man to be elected to office in the International Fellowship Club.

Bruno H. Schindler, superintendent of plating of the *Weiser Manufacturing Co.*, South Gate, Calif., was mustered into service as a buck private in the Southeast Unit, Fourth Regiment, California Home Guard, on June 12, and will be drilling twice a week hereafter.

"I think it is a good thing," said Mr. Schindler, who is a member of Los Angeles Branch, A.E.S., "for every man to know how to use a rifle to be ready when trouble comes."

Willard R. Shuler, superintendent of the plating department, *Namac Products*, 1027 North Seward Ave., Hollywood, Calif., was called to duty in the Naval Reserve on May 30 and is now stationed in the Panama Canal Zone. Shuler succeeded his father, *W. A. Shuler*, as superintendent of plating at Namac when the father resigned recently to affiliate himself with *National Aircraft Equipment Co.* of Los Angeles. *A. S. Maul* was named to succeed Willard as plating superintendent at Namac Products.

William J. Peters has been appointed Southern California sales representative for *R. N. Nason & Co.*, eastern manufacturers of lacquers, paints and varnishes, and has established headquarters at 2211 Barranca St., Los Angeles. Mr. Peters has already transferred his associate A.E.S. membership from Bridgeport, Conn., branch to Los Angeles Branch.

UNICHROME*
"AIR DRY"
RACK COATING

Remarkably resistant plating rack insulation drys in air— at room temperature!

Here's the new rack coating with a combination of properties that means valuable time and labor savings in the plating room.

Unichrome "Air Dry" Rack Coating withstands normal wear, hot cleaners and all plating solutions—without peeling, stripping or splitting. It produces thick, flexible coatings that: 1—Cannot contaminate the plating bath; 2—Adheres firmly even in severe plating cycles; 3—Cuts cleanly and easily at the contacts.

Here are the seven big time- and money-saving advantages at a glance:—

INSOLUBLE—withstands hot cleaners and all plating solutions

SAFE—contains no ingredients harmful to plating solutions

TOUGH—withstands wear and tear of handling

FLEXIBLE—withstands repeated flexing and bending

DURABLE—reduces the need for recoating

CONVENIENT—any part can be patched without recoating the entire rack

EASILY APPLIED—dipping is done in the container in which it is shipped—the material dries at room temperature.

Address requests for further information or a trial order to the nearest office below.

UNITED CHROMIUM
INCORPORATED

51 East 42nd Street, New York, N.Y.
2751 E. Jefferson Ave., Detroit, Mich.
Waterbury, Conn.

*Trade Mark
Reg. U.S. Pat. Off.

4-MAX

Serving You....

★ RUBBING COMPOUNDS
★ LIQUID POLISHES
★ DRAWING COMPOUNDS
★ POLISHING AND BUFFING COMPOSITIONS

We've got a free sample of our No. 750 Copper Buffing Composition for you. It's a honey! Send for it today.

• FORMAX MFG. CO., 3999 18th St., DETROIT, MICH. •

CHROMIC ACID

99.75% PURE

With two complete, independent plants at Jersey City and Baltimore, and its own supply of the basic raw material Chrome Ore from company owned and operated mines. Mutual is the world's foremost manufacturer of Chromic Acid. Warehouse stocks are carried in all principal industrial centers throughout the country.

BICHROMATE OF SODA

BICHROMATE OF POTASH

Mutual Chemical Co of America

270 MADISON AVENUE, NEW YORK

MUTUAL CHEMICAL CO OF AMERICA — MUTUAL — NEW YORK, N.Y.

Business Items

Blaw-Knox Company has announced the appointment of *Walter Nuttall* as General Purchasing Agent for the whole company, with offices in the Farmers Bank Building. Also announced was the appointment of *J. E. McWilliams* as Division Purchasing Agent of the Blaw-Knox Division, with offices to be located at Blawnox, Pa. Both Mr. Nuttall and Mr. McWilliams have been with the company for many years and are thoroughly conversant with industrial purchasing.

Quaker Chemical Products Corp., Conshohocken, Pa., have announced that *W. M. Paquin* has been added to the company's technical sales force in the Wisconsin territory. Mr. Paquin is a chemist with special training in ceramic engineering and was formerly in charge of enamel control work at the *Norge Division* of *Borg Warner Corp.*, Muskegon, Mich. His headquarters are at 2239 No. 59th St., Milwaukee, Wis.

Crowley & Bennett, with headquarters at 6803 N. Clark St., Chicago, Ill., and an Eastern branch at 228 King St., Brooklyn, N. Y., is a new firm of technical consultants. The principals, *Clyde A. Crowley* and *Harry Bennett*, are well known in their respective fields; the former for his work in electrochemistry and many other fields, and the latter as Editor-in-Chief of the Chemical Formulary and for his work on emulsions, special formulae and other modern chemical developments. The Chicago laboratories are especially equipped for electrochemical, lubrication, metallographic and other highly specialized problems.

Newest technical sales representative of the Pennsalt Cleaner Division of the *Pennsylvania Salt Manufacturing Company*, Philadelphia, Pa. is *Willis J. Stoddard*. Mr. Stoddard takes over the territory including Columbus, Cincinnati, Dayton, and Indianapolis with his headquarters at Dayton.

Mr. Stoddard, whose education includes a course in chemical engineering at the University of Detroit and quantitative analysis at Wayne University, brings to his territory the benefits of twelve years experience in the production end of his Company's business and in the chemical laboratory at Wyandotte.

This addition to the Pennsylvania Salt Manufacturing Company's technical sales force is necessitated because of the tremendous increase in business in that section of the country.

The Foxboro Co., Foxboro, Mass., manufacturers of industrial instruments for measurement and control, announces the addition of *Erwin Lawrence Gehrke* to the staff of sales engineers, attached to the New York branch. Mr. Gehrke, a graduate of Harvard University and New York University Engineering Courses, has had a varied experience which should prove valuable to the company's customers in the industrial area along the Atlantic seaboard.

News from California

Roger W. Sundmark, manager of the plating supply department of *Kelite Products, Inc.*, Los Angeles, has organized *Sundmark Supply Corp.*, which will handle some of the lines in the plating supply field for which Kelite has been serving as Southern California representative. Roger S. Sundmark is president and his brother, *Walter S. Sundmark*, is vice-president and secretary of the new organization, which has opened offices at 1821 Randolph St., Los Angeles.

Under the new setup, Kelite Products, Inc., has abolished its plating supply division which was opened by Roger Sundmark 18 months ago, and the inventory and goodwill has been taken over by the Sundmark brothers, who will henceforth handle such well-known lines as Bruce Products, Lea Manufacturing Co. and Hanson-Van Winkle-Munning. Kelite Products, Inc., will continue as a manufacturer of cleaning materials for metals, tire molds, etc.

Aircraft Components, Inc., of Los Angeles is constructing a drop hammer house of 5,000 square feet of floor area to supplement the facilities at its recently acquired 20,000 square foot plant at 800 Woodley Ave., Van Nuys, Calif. Approximately $75,000 are reported to have been invested in the plant, site and equipment for the manufacture of component parts, such as collector rings, ammunition boxes, carburetor shrouds and other stainless steel items.

Frank C. Rushton, vice-president of Los Angeles Branch, A.E.S., left June 20 for an extended trip to the middle west. Mr. Rushton is Southern California representa-

tive for *Lasalco, Inc.*, and planned to visit the home office of the company in St. Louis as well as making visits to Chicago and points in Minnesota.

Johnson & Stevenson, Inc., has opened a new plant at 2306 East 38th St., Los Angeles, in which precision aviation parts are being produced. Initial staff consists of 35 workmen.

Mark Comiskey, president of *Merco Manufacturing Corp.*, 3636 Irving St., Los Angeles, announced in June that the company has completed equipment installations for beginning the manufacture of tools, dies, jigs and fixtures.

Reginald Facer, head of *Efco Manufacturing Co., Ltd.*, New South Wales, Australia, and former chemist for the Australian Alloy Steel Co., was taken into membership of Los Angeles Branch in June.

Another Australian accepted into membership of that branch in June was *G. W. Walker*, manager and technical adviser of *A. G. Healing, Ltd.*, Sidney, Aust.

A 7000 square foot addition has been completed by *Mechanical Development Co.*, 1000 North Orange Drive, Los Angeles, to take care of expanded activities in the manufacture of dies, tools and stampings.

Meta-Mold Casting Co., has been organized in Los Angeles by *Walter Rachael, James C. Titus* and *William D. Witherspoon.*

An eight-acre tract has been acquired at 631 South Inglewood-Redondo Blvd., in Inglewood, Calif., by the *Menardi Metals Co.* of 2310 East 52nd St., Vernon, Calif., as the site for the first unit of a manufacturing plant to produce antimony metal, antimony trioxide and quicksilver.

Plumbing specialties and barbecue equipment will be manufactured in a new 3,000 square foot addition just completed by the *American Foundry Co.* at 7001 Anaheim-Telegraph Road, in Belvedere Gardens, east of Los Angeles.

A new plant covering 75,000 square feet of working area is being erected at 2665 Leonis Blvd., Los Angeles, by *Poulson & Nardon, Inc.*, now at 841 South Central Ave. The company manufactures aircraft parts, screw machine products, dies and stampings.

Louis H. Seagrave has resigned as chairman of the board of the *National Postal Meter Co.* of Los Angeles to become president of *National Machine Products*, a newly incorporated concern, which has taken over a factory at 150 W. Slauson Ave., Los Angeles, for the manufacture of machine units for airplane plants. *Robley F. Sopris* will serve as vice-president and general manager.

The Slauson Ave. factory includes 63,500 square feet of area.

The Foxboro Co., Foxboro, Mass., announces that *Frank Revell* has joined the staff of sales engineers attached to the company's New York office. For the past five years, Mr. Revell has been employed in the Instrument Maintenance Department of the *Calco Chemical Co.*, Bound Brook, N. J.

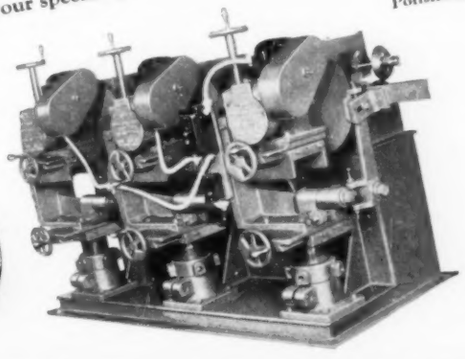
The ACME METHOD OF Tube and Pipe POLISHING

✓ INCREASES PRODUCTION
✓ INSURES BETTER FINISH
✓ at Lower Cost

Polishing costs take a licking all along the line when this Acme 3-Wheel Automatic bites into a tough job of tube or pipe finishing. It gives a three-way savings by performing three operations in one pass through the machine. Adjustable feed speeds from 0 to 20 or more feet per minute and compensating adjustments for tube size and wheel wear meet every production and finish requirement.

Investigate the advantages the Acme Method has to offer you on an application to meet your specific problem. Write Acme—no obligation.

Type T-3
3-Wheel Automatic
Polishing Machine



SPECIAL MACHINERY AMC AUTOMATIC BUFFING MACHINES

ACME Manufacturing Co.
1642 HOWARD ST. • DETROIT, MICH.
Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

Patent Digest

Colored Gold Alloy

U. S. Patent 2,243,177. L. Weiss (Germany), assignor to Chemical Marketing Co., Inc., May 27, 1941. A workable gold alloy having a purple colored shade consisting of from about 68.5% to about 78.5% gold, 0.5%-10% thorium and the remainder substantially all aluminum, the aluminum constituting not over 24.25% of the alloy.

Detergent

U. S. Patent 2,243,054. J. G. Vail, assignor to Philadelphia Quartz Co., May 20, 1941. As a new detergent, particles of an expanded alkali metal silicate substantially uniformly combined with at least 5% of an alkali metal soap formed in situ by reaction of said particles of alkali metal silicate with a high molecular fatty acid, said particles containing slightly larger proportions of soap on their surfaces than in their interiors, said detergent having an apparent specific gravity between about 1.0 and 0.9.

Colored Gold Alloy

U. S. Patent 2,243,023. L. Weiss (Germany), assignor to Chemical Marketing Co., Inc., May 20, 1941. A workable gold alloy having a purple colored shade consisting of 75 parts gold, 24.25 parts aluminum, 0.25 parts thorium and 0.5 parts tin.

New Improved

LUSTREBRIGHT

BRIGHT NICKEL PROCESS

PRODUCES BRILLIANT, LUSTROUS NICKEL DEPOSITS.
ELIMINATES COLOR BUFFING—RE-CLEANING—RE-RACKING.
AN IDEAL BASE FOR CHROMIUM. EXCELLENT THROWING POWER.
NO SPECIAL SOLUTIONS OR CHANGES IN EQUIPMENT REQUIRED.
EASY TO CONTROL—LOW IN COST—SUCCESSFUL—PRACTICAL.

Uniform results obtained on all classes of work in still tanks or mechanical barrels. Excellent for zinc die-castings. Any cold nickel solution of standard formula will with the addition of NEW IMPROVED LUSTREBRIGHT give brilliant, lustrous, adherent deposits. Guaranteed not to harm plating solution or cause plate to peel, become brittle or produce streaky deposits. Illustration shows unbuffed deposits produced before and after addition of NEW IMPROVED LUSTREBRIGHT. Write for complete information.

W. C. BRATE COMPANY

EST. 1860 ALBANY, NEW YORK

FOR STRIPPING COPPER

McKEON'S

"Liquid Sulphur"
TRADE MARK REG'D

"THE OXIDIZING AGENT OF TODAY"

Sample FREE Service

SULPHUR PRODUCTS CO. Greensburg, Pa.

A NEW NICKEL STRIPPING PROCESS USING

STRIPODE
(Patent applied for)

An inhibiting agent for Sulphuric Acid strip baths that—

PREVENTS PITTING AND ROUGHENING OF THE BASE METAL

(Steel, brass, zinc die castings, heavy zinc and lead bearing alloys)

STRIPODE

Reduces Finishing Costs to a Minimum
Reduces Stripping Time by 50% or More in Many Cases
Reduces Your Scrap Loss
Strips Plating Racks
Saves Acid

Write for information and literature

CHEMICAL CORPORATION 93 Broad Street
SPRINGFIELD, MASSACHUSETTS

Pickling Strip Steel

U. S. Pat. 2,238,667. C. C. Wales. April 15, 1941. An apparatus for pickling strip steel.

Cleaning Machine

U. S. Pat. 2,239,714. C. H. Hammell, assignor to The American Foundry Equipment Co., April 29, 1941. A conveyorized apparatus for blast cleaning castings, forgings and the like.

Tumbling Machine

U. S. Pat. 2,239,904. K. G. Soderberg, assignor to The Udylite Corp., April 29, 1941. A machine for wet tumbling comprising a tank and a U-shaped frame in which are held perforated baskets with removable covers.

Cleaning Machine

U. S. Pat. 2,240,246. C. H. Hammell, assignor to The American Foundry Equipment Co., April 29, 1941. A conveyorized apparatus for blast cleaning castings, forgings and the like.

Cleaning Machine

U. S. Pat. 2,240,248. D. C. Turnbull, assignor to The American Foundry Equipment Co., April 29, 1941. A conveyorized apparatus for blast cleaning castings, forgings and the like.

Tin Plating

U. S. Pat. 2,240,265. J. S. Nachtman, April 29, 1941. In a method of making a bright tin electroplated continuous metal strip the steps of cleaning by wet brushing, electroplating and brightening the coating by subjecting the same to a medium maintained at a temperature sufficient to alloy the tin with the strip, continuously moving the strip by application of propulsive power at a plurality of steps, this also serving to control the tension of the strip.

Pickling Inhibitor

U. S. Patent 2,203,649 P. F. Felkers, assignor to Stikstofbindingsindustrie (Netherland). Patent claims a pickling bath containing a substance of the group of non-oxidizing acids and non-oxidizing acid salts and a substance of the group constituted by the alkylthiocyanates and the aralkylthiocyanates.

Example:

Benzyl thiocyanate, methyl thiocyanate and dithiocyano-ethane. The addition of thiocarbanilide may also be made along with the above.

Buffing Wheel

U. S. Patent 2,244,582. F. H. Thompson, assignor to Divine Bros. Co., June 3, 1941. A buffing wheel of disc-like layers of material having the middle portions impregnated with a hard-setting adhesive or size.

Zinc Anodes

U. S. Patent 2,243,696. E. W. Ferm, assignor to E. I. duPont de Nemours & Co.,

May 27, 1941. Reduction of the anode efficiency in zinc plating to correspond to that of the cathode by incorporating about 0.01%-1.0% of alloyed magnesium, the zinc-magnesium alloy having been heated to a temperature not substantially lower than about 700° C., prior to casting into anode form.

Removal of Plating Salts from Crevices

U. S. Patent 2,207,808 M. A. Lamme, assignor to Western Electric Co., Inc. A method of removing remnants of electrolytic salts in water solution from the crevices of jointed electroplated articles which comprises displacing said substances in said crevices by subjecting said articles to the action of a material selected from the class consisting of trichlorethylene, tetrachlorethylene and carbon tetrachloride. The article is immersed in hot water after plating and then given the following dips:

1 Dip in cold trichlorethylene
2 Dip in hot trichlorethylene
3 Subject to trichlorethylene vapors
4 Dry in air

All these steps may not be necessary: only one may be sufficient in a given case.

Recovering Tin and Steel from Tin Plate

U. S. Patent 2,208,138 R. T. Robinson. A process of treating tin plate for removal of the tin which comprises contacting the plate in a counter-current manner with a solution approximately 0.06 molal in stannic chloride and approximately 0.27 molal in ferrous chloride, the oxidation of the solution *not* being beyond the stage necessary to convert all of the tin salts to the stannic form, with sufficient free hydrochloric acid to produce a pH of —0.27.

The rate of attack on the tin is at least 10 times and usually more than 20 times the rate of attack of the solution on iron. The hydrochloric acid is sufficiently high to prevent the precipitation of tin and iron salts but not high enough to effect hydrogen evolution on the base during stripping. The ferric ion content should be kept down to prevent attack on the steel. It should not be beyond the amount required to oxidize all the tin salts to stannic form.

Passivating Stainless Steel

U. S. Patent 2,209,924 R. W. E. Leiter and J. Winlock, assignors to Edward G. Budd Mfg. Co. Stainless steel is made proof against corrosion by aqueous solutions of sulfuric acid by treating with dilute sulfuric acid for about 24 hours at 80° F., the solution containing substantially about 3% sulfuric acid, until a smudge is produced on the surface and then exposing the stainless steel to air for a considerable period to produce an oxide protective coating against subsequent attack by sulfuric acid other than concentrated or fuming sulfuric.

Metal Spraying

U. S. Patent 2,058,653. F. O. Albertson, assignor to Albertson & Co., Inc., Oct. 27, 1936, reissue 21,814 June 3, 1941. A spray gun for spraying metal.

DIAL YOUR OWN POLISHING SPEED

1500-3000 RPM Instantly with the HAMMOND "VRO" Variable Speed POLISHER

For more wheel economy, maximum production and better finish, peripheral speed must be kept constant as wheels wear down. It's easy with the HAMMOND "VRO". Just turn a dial mounted conveniently right in front of the operator. Instantly, speed is altered, point-by-point, anywhere between 1500 and 3000 RPM. Find out how the VRO can help you. Write TODAY for BULLETIN GP-30.

Hammond of Kalamazoo
HAMMOND MACHINERY BUILDERS, INC.
1601 DOUGLAS AVE. · · · KALAMAZOO, MICHIGAN
Eastern Branch—71 West 23rd Street, New York City

Colored Oxide Coatings on Nickel and Nickel Alloys

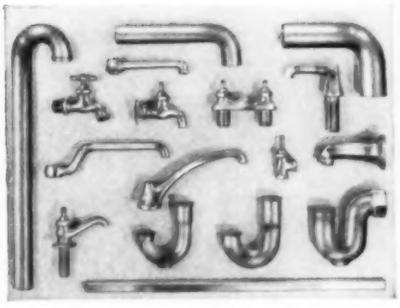
U. S. Patent 2,206,392. C. G. Crocker, G. K. Crosby and R. R. Clappier, assignors to the International Nickel Co. A process of producing adherent blackish uniformly colored oxide coatings on rolled products of nickel alloys, selected from the group containing about 2%-5% manganese and the balance substantially all nickel, nickel-copper alloys containing about 30% copper, about 1% manganese, about 1% iron and the balance substantially all nickel, and nickel-chromium-iron alloys containing about 11% to about 15% chromium, about 5% to about 10% iron and the balance substantially nickel, which comprises exposing the cleaned rolled product to a heated oxidizing atmosphere effective to produce a uniform blackish oxide coating on the surface thereof, while maintaining said product at selected elevated temperatures within the range of about 1550° F. to about 2200° F., for a period of time of the order of about ½ minute to about 4 minutes whereby rolled nickel alloy products are produced having an adherent blackish coating characterized by uniformity and stability of color. Coatings may be green, brown, blue-black or black depending on the temperature, time and composition.

Stripping Copper from Iron

U. S. Patent 2,241,585. W. E. Day, Jr., assignor to Mack Mfg. Corp., May 13, 1941. The removal of copper plate from ferrous metal by reverse current at 20-30 amperes per sq. ft. in a solution of about 12%-15% by weight of ammonium nitrate and 5%-10% by volume of 26° Be. ammonia, the remainder water. Example:

Ammonium nitrate	15% by weight
26° Be. ammonia	10% by volume
25 amperes per sq. ft.	

If the bath becomes saturated with copper, the copper can be plated out using steel anodes.



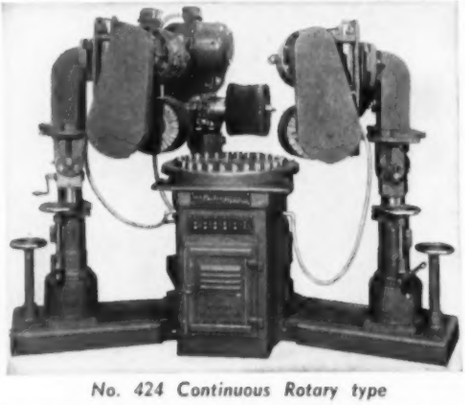
PLUMBERS BRASS GOODS

Automatically Finished on
PACKER-MATIC

CUT COSTS

INCREASE PRODUCTION

Odd shaped parts, difficult to handle are Polished and Buffed, Automatically, on the centralized controlled PACKER-MATIC. ROTARY—STRAIGHT LINE CONVEYOR—ROLL types . . . SEND part for time study, gratis. WRITE Dept. P.



No. 424 Continuous Rotary type

•AUTOMATIC POLISHING & BUFFING MACHINES

Packer-Matic

THE PACKER MACHINE CO., MERIDEN, CONN., U. S. A.

Thickness Of Coatings on Metals Now Measured Rapidly and Non-destructively

AMINCO-BRENNER

MAGNE-GAGE

AMINCO

Measures Thickness of:

Magnetic Coatings on Non-magnetic Base Metals
Non-magnetic Coatings on Magnetic Base Metals
Nickel Coatings on Iron or Steel

RAPID . . permits testing of a large number of specimens at low cost, with little experience.

NON-DESTRUCTIVE . . . will not injure the coating or the base metal, thus effecting great savings.

UNIVERSAL . . . applicable to plane, convex or concave surfaces.

COMPACT . . . PORTABLE . . . weighs only 7½ lbs.

Ideal for Works Control or Acceptance Testing

Write for Bulletin MF-2070

AMERICAN INSTRUMENT CO.
8010 GEORGIA AVENUE · SILVER SPRING, MARYLAND

SPECIALIZING . . . .
IN THE DESIGN AND CONSTRUCTION OF WIRE MESH BASKETS AND CRATES
for

Dipping
Pickling
Degreasing
Anodizing
Drying
Plating

Brazing
Annealing
Hardening
Quenching
Galvanizing
Centrifugal work

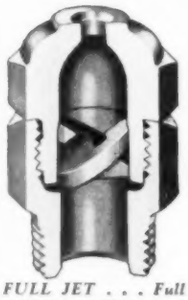
Let ROLOCK design and fabricate your baskets and crates of the proper metal or alloy for the particular job to be done.

ALL WELDED CONSTRUCTION FOR PERMANENCE AND SAFETY

WRITE FOR CATALOG

ROLOCK INC

18 STATION ST. SOUTHPORT, CONN.



FULL JET . . . Full cone spray pattern, even distribution. Made of all metals.

FLAT SPRAY . . . Produces a flat, hard-hitting stream. Shown here in our adjustable joint for changing angle.

SPRAY cleaning
• is more efficient
•• much faster
••• and cheaper

Nowadays when metal-finishing plants are working at full capacity, you owe it to yourself to check on your cleaning methods—spray cleaning is the fastest and surest method of cleaning and degreasing metal parts of any size and shape.

If you already are using spray-cleaning, check on your nozzles to see if they are working at full efficiency. Worn, corroded nozzles cut down production and waste cleaning fluid. It's cheaper to replace them with new, efficient Spraying Systems Nozzles.

If you have a problem regarding spray systems or nozzles, write us today. Our engineers specialize in this field alone. Our new 1941 catalog contains valuable data on this subject. Write for it now! SPRAYING SYSTEMS COMPANY, 4039 West Lake Street, Chicago, Illinois.

SPRAY NOZZLES AND ACCESSORIES

SPRAYING SYSTEMS CO.

Supply Prices, June 27, 1941

Anodes

Prices are f.o.b. shipping point on quantities of from 500-999 lbs. for copper, brass and zinc. For nickel, prices are for quantities from 500-2,999 lbs.

COPPER: Cast, elliptical, 15" and longer ..... .25⅛c. per lb.
Electrolytic, full size, .22⅞c; cut to size .22⅞c. per lb.
Rolled, oval, straight 15" and longer .23¼c. per lb.; curved ..... .24¼c. per lb.
BRASS: Cast, 80-20, elliptical, 15" and longer .... .23⅝c. per lb.
ZINC: Cast, 99.99, 16" and over ..... 15¼c. per lb.
NICKEL: 95-97 cast, elliptical 46c. per lb., 99% plus cast 47c.; Rolled, depolarized ..... 48c. per lb.
SILVER: Rolled, .999 fine per Troy oz. ..... 38c. per oz.

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, C.P., drums, l.c.l.	lb.	.09
Acid, Boric tech., 99.5% gran., bbls.	lb.	.0615
Chromic, 99%, 100 lb. and 400 lb. drums, l.c.l.	lb.	.18¼
Hydrochloric (muriatic) Tech., 20°, carboys, wks.	lb.	.0270
Hydrochloric, C.P., 20°, bottles	lb.	.19
Hydrofluoric, 30% bbls.	lb.	.06-.06½
Nitric, 36°, carboys 1-9, wks.	lb.	.0595
Nitric, 42°, carboys 1-9, wks.	lb.	.0745
Oleic (Red Oil), distilled, drums	lb.	.12
Oxalic, bbls. l.c.l.	lb.	.14
Stearic, distilled, double pressed, bags	lb.	.13¼-.14¼
single pressed, bags	lb.	.12¾-.13¾
triple pressed, bags	lb.	.16-.17
Sulphuric, 66°, carboys 1-9, wks.	lb.	.0220
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.17½-.19½
Butyl-normal, l.c.l., drums	lb.	.11½
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.35
Diacetone, tech., drums, l.c.l.	lb.	.12-.12½
Methyl, (Methanol), 93%, drums, l.c.l.	gal.	.48½
Propyl-Iso, 99%, drums, l.c.l.	gal.	.43-.47
Propyl-Normal, drums, wks.	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.035
Potash, granular, bbls., works	lb.	.0375
Ammonia, aqua, 26°, carboys	lb.	.05¼
Ammonium, chloride (sal-ammoniac), white, granular, bbls., wks.	lb.	.0445
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	.65
Sulphocyanide (thiocyanate), tech., kegs	lb.	.40
Antimony Chloride (butter of antimony), sol., carboys	lb.	.17
Barium Carbonate, ppted., bags, l.c.l., works	lb.	.025
Benzene (Benzol), 90%, drums, works	gal.	.19
Butyl Lactate, drums	lb.	.235
Cadmium Oxide, l.c.l., bbls.	lb.	.95
Calcium Carbonate (Ppted. chalk), c.l., wks.	lb.	.02¾
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾
Carbon Tetrachloride, l.c.l., drums	gal.	.73
Chromic Sulphate, scale, 100 lb. drums	lb.	.45
Cobalt Sulphate, drums	lb.	.71
Copper, Acetate (verdigris), bbls.	lb.	.26
Carbonate, 52-54%, bbls.	lb.	.16½
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, 99%, crystals, bbls., 1-5	lb.	.0535
Cream of Tartar (potassium bitartrate), gran., kegs	lb.	.53½
Crocus Martis (iron oxide) red, bbls.	lb.	.03
Dibutyl Phthalate, drums, l.c.l.	lb.	.195
Diethylene Glycol, drums, l.c.l., works	lb.	.155
Dextrin, white, bags, F.O.B. Chicago	lb.	.0395
Emery (Turkish)	lb.	.08
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.075
Ethylene Glycol, l.c.l., drums, works	lb.	.15½-.18½
Monoethyl ether, dms., l.c.l., wks.	lb.	.125-.155
Gold, Chloride, yellow, bottles	oz.	$19.25
Cyanide, potassium 41%, bottles, wks.	oz.	$14.20-$14.95
Gum, Arabic, white, powder, bbls.	lb.	.21-.22
Hydrogen Peroxide, 100 volume, carboys	lb.	.16-.18½
Iron Sulphate (Copperas), cryst., bbls., 1-4 wks.	lb.	.02
Lead, Acetate (Sugar of Lead), crystals, bbls.	lb.	.12½
Oxide (Litharge), com., powdered, bbls.	lb.	.08¼
Magnesium Sulphate (Epsom Salts), tech., bbls.	lb.	.018
Mercury Bichloride (Corrosive Sublimate), crys.	lb.	$2.19
Mercuric Oxide, tech., red, powder, bbls.	lb.	$2.81
Nickel, Carbonate, dry, bbls.	lb.	.36-.36½
Chloride, bbls.	lb.	.18-.20
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin, refined, bgs., 123-125 a.m.p., c.l.	lb.	.057
Perchlorethylene, drums, l.c.l.	lb.	.08½
Phosphorus, red, cases	lb.	.44
yellow, cases	lb.	.23-.25
Potash, Caustic, 88-92%, flake, drums, works, c.l.,	lb.	.07
Potassium, Bichromate, crystals, casks	lb.	.10
Carbonate (potash) calc., wks. drums		.06¾
Cyanide, 94-96%, dom. dms., wks.	lb.	.55
Pumice, ground, 1½ F. & coarser, bbls., wks.	lb.	No price
Quicksilver (Mercury), dom. 76 lb. flasks, net	flask	$188.
Rochelle Salts, crystals, bbls.	lb.	.40
Rosin, gum, B, bbls., dock	lb.	.0233
Silver, Chloride, dry, 50 oz. lots	oz.	.37½
Cyanide, 100 oz. lots	oz.	.33¾
Nitrate, 100 oz. lots	oz.	.24
Sodium, Carb. (soda ash), light, 58%, bags	lb.	.0208
Cyanide, 96%, dom. 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake, l.c.l.	lb.	.0490
Hyposulphite, crystals, bags, wks.	lb.	.0250
Metasilicate, granular, 1-9 bbls.	lb.	.0335
Nitrate, rfd., gran., bbls., wks.	lb.	.029
Phosphate, tribasic, tech., bbls., wks.	lb.	.0295
Pyrophosphate, anhydrous, bags, l.c.l.	lb.	.0560
Sesquisilicate, 1-9 drums	lb.	.0425
Stannate, drums	lb.	.037
Sulphate, anhydrous, bbls., works	lb.	.0215
Sulphocyanide, drums	lb.	.28-.47
Sulphur, Flowers, U.S.P., bbls., l.c.l. mine	lb.	.0335
Tin Chloride, crystals, kgs.	lb.	.40
Toluene (Toluol), 2°, ind., drums, works	gal.	.32
Trichlorethylene, drums, l.c.l., zone 1	lb.	.08½
Tripoli, air floated, bgs., c.l., wks.	ton	$26.00
Wax, Bees, white, bleached, slabs, 1-5 cases	lb.	.43-.44
Bees, yellow, crude, Brazil, 100 lbs.	lb.	No stocks
Carnauba, refined, bags	lb.	.73
Montan, bags	lb.	No prices
Spermaceti, blocks	lb.	.24-.25
Whiting, precipitated, bags, l.c.l.	ton	$20.00
Xylene (Xylol), ind., returnable drums, works	gal.	.31
Zinc, carbonate, tech., bbls.	lb.	.14-.16
Cyanide, 100 lb. kegs	lb.	.33
Chloride, tech., granular, drums, c.l., wks.	lb.	.05
Sulphate, crystals, bbls., l.c.l.	lb.	.039

PERMAG —the Cleaning Compound used in many Defense Industries

Says Magnuson: Where metals must be cleaned quickly—thoroughly and as inexpensive as possible, PERMAG is chosen for the job.

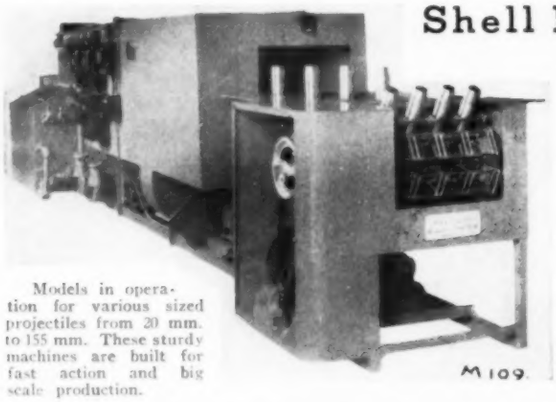
PERMAG Cleaning Compounds clean aluminum and soft metals without leaving a trace of injury to the metal. When a difficult job comes, the Magnuson Research Service takes it over, and with PERMAG the problem is soon solved economically and with satisfaction.

Write us about your problem. No obligation for an interview.

MAGNUSON PRODUCTS CORPORATION

Third & Hoyt Sts. BROOKLYN, N. Y.

Manufacturers of Specialized Scientific Cleaning Compounds for every Industrial Purpose. Warehouses in principal cities of U. S. Representatives from Coast to Coast. IN CANADA: Canadian PERMAG Products Ltd., Montreal and Toronto



Models in operation for various sized projectiles from 20 mm. to 155 mm. These sturdy machines are built for fast action and big scale production.

M109

Shell Makers Reduce Cleaning Costs by using Metalwash Automatic SHELL CLEANING and DRYING MACHINES

Many years of engineering experience and skilled construction design are embodied in Metalwash machines.

Arsenals and firms engaged in National Defense Work are using our products.

We cordially invite interviews on engineering problems in the metal cleaning field. Write us.

METALWASH MACHINERY COMPANY, Inc.
27-29 Haynes Ave. Newark, N. J.

BOGUE

Oldest Exclusive Manufacturers of

PLATING & ANODIZING GENERATORS

100-25000 Amperes 4-50 Volts. AC & DC Motors—Special Units—Case hooks—Long life "Bogue" Brushes. STOCK SHIPMENT on units 500-6000 Amperes.

BOGUE ELECTRIC COMPANY
80 Glover Ave., Paterson, N. J.

NICKEL SILVER

Sheets—Rolls

Phosphor Bronze, Bronze Gilding Metal
Low Brass and Special Alloys

WATERBURY ROLLING MILLS, Inc.
Waterbury, Conn.

266 Users of

TANTOL BRIGHTENER

Not One Single

COMPLAINT

(Used 3½ ounces per 100 gallons)

PRICE: 16 ounces $3.50—Gallon $22.50

LINICK, Inc. 29 E. MADISON ST. CHICAGO

P.S.: "Ductyl" Cures Brittleness!

ATTENTION PLATERS

For 30 years we have manufactured and sold a guaranteed line of

POLISHING AND BUFFING COMPOSITIONS

Free Samples Gladly Sent Upon Request

E. J. WOODISON CO.
7415 St. Aubin St. Detroit, Mich.